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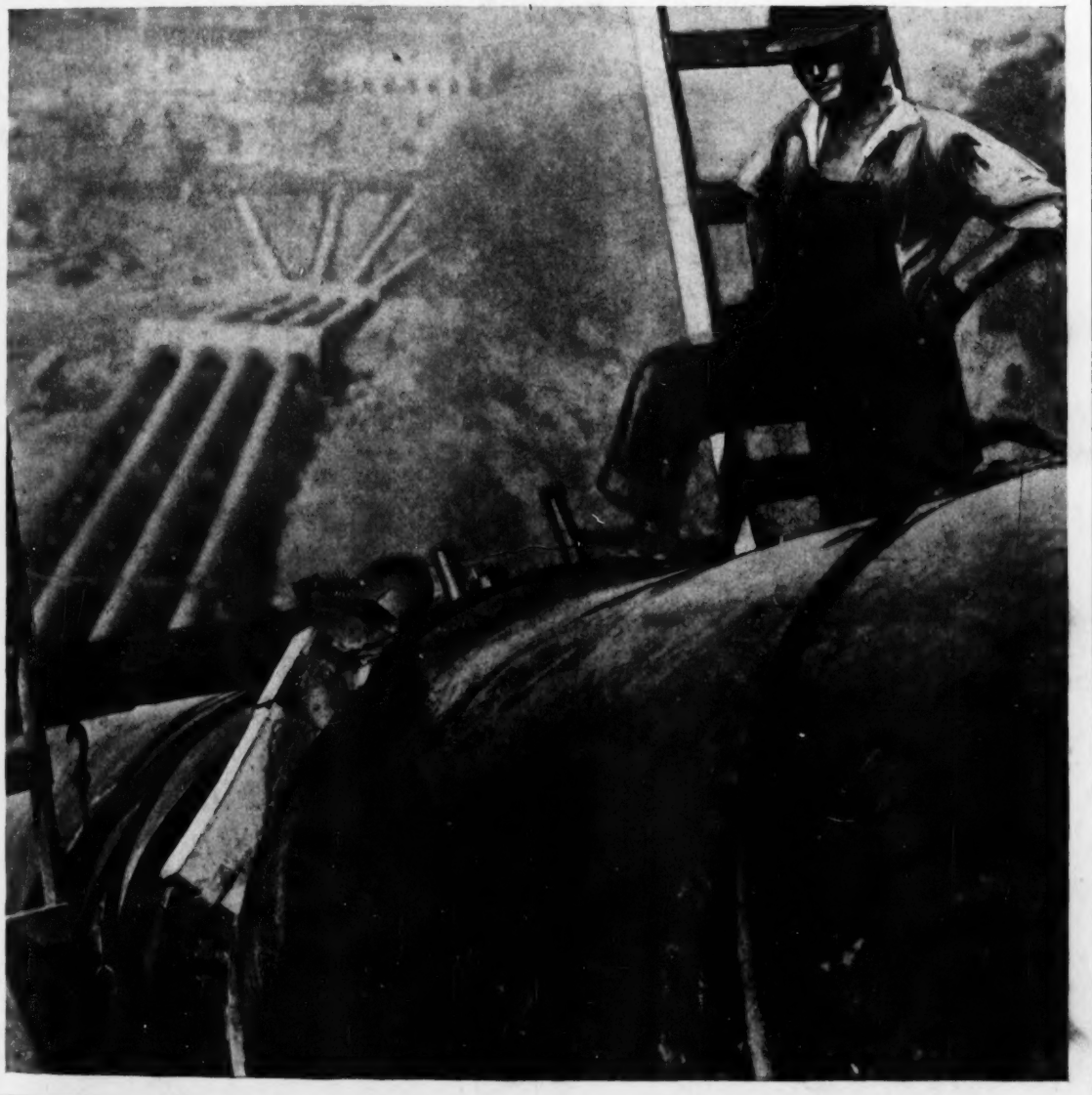
Engineering News-Record



Vapor Heating a Joint in Penstock Line, Moccasin Creek, California

Building the Moccasin Creek Penstock of the Hetch Hetchy Project

Cable-Operated Pontoon Bridge Over the Chicago River

Shoving of Asphalt Pavements Overcriticized

Replacing Railway Truss Span with Two Girder Spans

21 below zero~ and erection is not stopped!

DURING the erection of the plant of the Riverside Fibre and Paper Co., at Appleton, Wisconsin, in January, the temperature reached 21 below. This didn't hold up the laying of the roof of Federal Cement Tile—it was laid in twelve working days.

Many a Federal roof is laid in zero weather. Among the large installations completed this winter are

Otis Elevator Co., Quincy, Illinois
31 working days, 18 below zero

Goss Printing Press Co., Chicago
11 working days, 14 below zero

John Marshall High School, Minneapolis
7 working days, 20 below zero

Herbrand Co., Fremont, Ohio
23 working days, zero weather; plant shown below.

Don't these illustrations prove that Federal Cement Tile is the ideal roof for winter work? The booklet, "Covered With Federal," will tell you why it's best at all seasons, for all types of buildings.

Made, Laid and Guaranteed by
FEDERAL CEMENT TILE COMPANY
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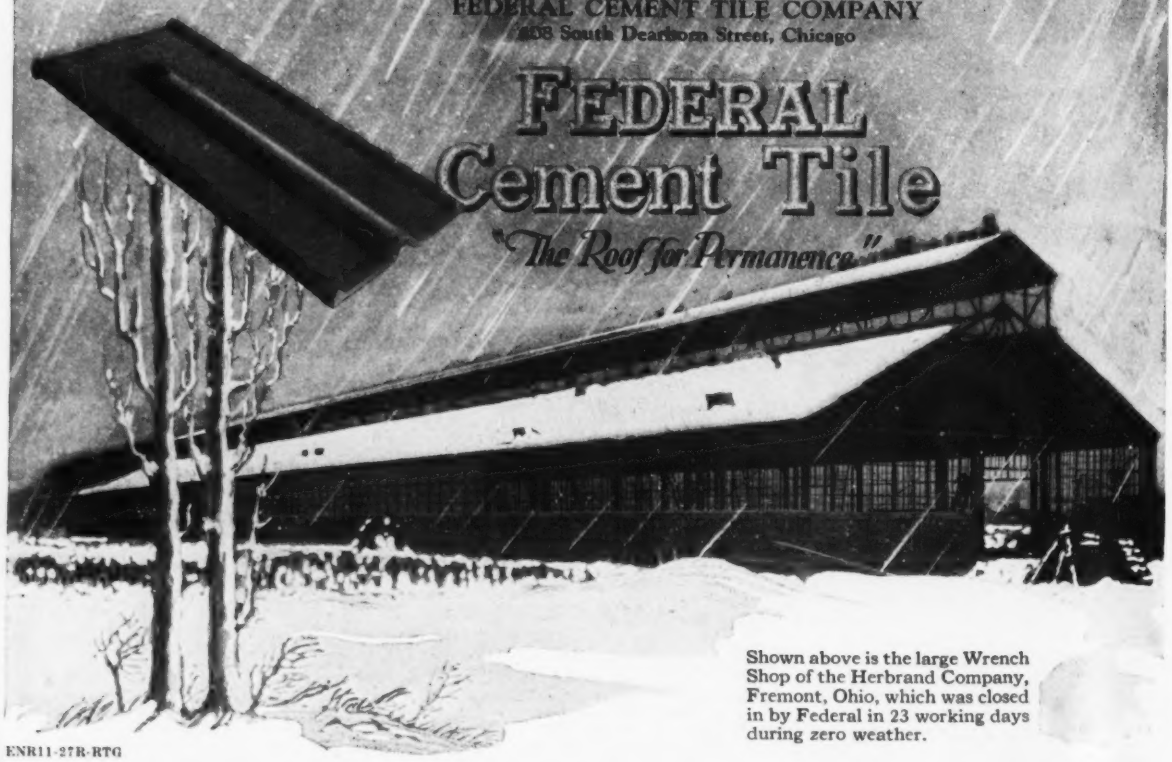
FEDERAL Cement Tile
"The Roof for Permanence"



Shown above is the large Wrench Shop of the Herbrand Company, Fremont, Ohio, which was closed in by Federal in 23 working days during zero weather.

ENR11-27R-RTG

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

McGraw-Hill Company Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 93 NEW YORK, NOVEMBER 27, 1924 Number 22

To Bid or Not To Bid

THE campaign of the contracting fraternity to force the Reclamation Bureau to relinquish its long established custom of doing its own construction was not very successfully forwarded by the episode of the American Falls dam building. If the contractors wanted to show Secretary Work, as they rather too vociferously claimed they wanted to show him, how much more advantageously to the government reclamation construction could be carried on by contract than by the Bureau's own engineers, who are long experienced in just this sort of construction, one would have thought that at least they would have backed up their own campaign to the extent of offering competitive bids. Two bids on such a sizeable job hardly represent competition—and it should be clear to the most violent opponent of force-account work that public policy demands competitive bidding as the primary requisite of contract work. As we have pointed out before, the general arguments in the case against force-account construction cannot be maintained in the peculiar conditions and circumstances of Mississippi River levee work or pioneer construction such as the Reclamation Service for years has been doing. The only excuse the government would have in reverting to the contract system would be the promise of lower cost, and the only insurance of lower cost is the free competition of bidding. That the contractors in the West did not see fit to take the essential initial step to prove their case shows a not too great confidence in the rightness of their cause.

Holland Tunnel and Smith Bridge

TWO great engineering projects, one under the Hudson River and one over it, are to bear the names of men who gave freely of their energies in an effort to bring them to completion only to die before the work was finished. Last week the announcement of the naming of the vehicular tunnel under the Hudson River between New York City and Jersey City for the late chief engineer of the commission, Clifford M. Holland, was made in our news pages. This week's issue contains the announcement that the great railroad bridge across the same river, near Albany, has been named for the late president of the New York Central R.R., Alfred H. Smith. In both cases the extent of the honor conferred will depend largely upon how well the names can be fixed upon the structures. In the case of the vehicular tunnel, some form of marking at the portals may serve to impress the name Holland upon the thousands of automobile drivers who pass through the tunnel, but in the case of the railroad bridge no such method of marking would avail because it is for freight service and consequently, except for a comparatively few railroad employees, the many people who will look upon it daily will do so from a distance, from trains in the river valley, from boats on the river, and from the highways skirting the bluffs. It is to be hoped that the railroad company will find some way of impressing the new name of the bridge upon the public mind to replace the unofficial name of "Castleton Bridge" which it now bears, and that the New York and New Jersey tunnel commissions will take steps to display the name Clifford M. Holland at conspicuous points on the vehicular tunnel, so that in both cases the naming of the structures will be something more than a mere gesture.

Highway Safety and the Engineer

NINE months have now been covered by the accident statistics of the National Automobile Chamber of Commerce. In that period there have been 5498 fatalities due to automobile traffic. Of these fatal accidents, 1923, the cause of which was determinable, have been classified in three groups each containing six or seven sub-groups. Of the 1923 fatalities, the motorist is assigned as responsible for 692, the pedestrian for 893, and physical conditions for 338. Of the seven physical conditions listed as causes of accident only two, skidding and defects in road, indicate faulty highway structure. In fact skidding is as likely to be a fault of driving or of the vehicle as of the condition of road structure, but let the highway take all the blame and notice what is had. There were 81 fatalities from skidding and 29 due to defects in road. In over 1900 deaths only 110 were due to the condition of the track over which the fatal vehicles were traveling. While accepting a little pridefully this indication that he is doing his work well the highway engineer will not be too uplifted. He knows of too many danger points—grade crossings, blind curves, narrow bridges and other faults of structure—which must be eliminated before his highway will pass muster as a safe way for traffic.

By 1930 or Earlier

IF THE legislatures of Arizona, Nevada and South Dakota will only pass laws providing for the registration of births and deaths then every state in the Union will be within or on the way to the registration area and the United States that much nearer to gaining a place with the other civilized nations of the world in recording and publishing vital statistics for the whole country. But more than legislation is required, for ten states are still outside the birth and 16 outside the death registration area, the three already mentioned for lack of legislation and the others because, although having statutory authority that they still lack administrative machinery, including personnel and appropriations. Engineers are more interested in death than in birth registration. The 10 states still outside the death registration area have about 12 per cent of the population of the country. Engineers and their societies might well join in urging the legislators and

administrative officers of the delinquent states, which are shown in the article in this issue, to help the Census Bureau realize its aim, as expressed in the slogan, "Every state in the registration area before 1930." That accomplished, the Census of 1930 will have added meaning and the health, wealth and happiness of the country increased.

Codify Road Laws

CONNECTICUT which began to be notable for improved highways only a little later, even nominally, than did Massachusetts and New Jersey, is feeling the need of clearing up and simplifying its road laws. This winter, it is announced, the Legislature will be asked to undertake revision and codification of the widely scattered and in many cases obsolete acts that have accumulated in over three decades of state highway administration. There was a measure of such simplification in the 1918 revision of the Connecticut statutes, but subsequent amendments have been numerous and the whole body of highway laws needs overhauling so that highway department officials can conduct its business expeditiously. This proposed action in Connecticut is of interest because it emphasizes a condition which prevails in every state, even those whose improved road activities are only a few years old, and from which every state highway department head would appreciate relief. It will be hoped that the codification which the Connecticut highway commissioner is preparing for legislative consideration will set a high example which other states can follow.

Two Trade Associations

TWO trade association meetings are reported in this issue. One of these, the Portland Cement Association, is of long standing; the other, the American Institute of Steel Construction is new. But the meetings of both showed the best features of the trade association idea, that is, the exchange of necessary and vital information by the technical experts of the industry. The school of thought opposing the trade association, best exemplified by the Harding Department of Justice, could see in these agencies only evil purpose and performance. But actual performance has contradicted this narrow legalistic view. The cement men, so far as their association goes, have joined together only to the good of the industry and the users of their product. The younger association of steel fabricators has not yet had time to find itself as thoroughly as the older but that it is on the right track, the meeting at French Lick last week showed. If it continues to take as broad a view of its responsibilities its future is bright.

International Co-operation

IN A graceful speech at the centenary dinner of the Portland Cement Association last week the dean of the industry, Robert W. Lesley, passing in review the presidents of the association referred to the latest past-president, Frederick W. Kelley, as "the internationalist." This deserved recognition of one of Mr. Kelley's most important contributions to the association and the industry it embraces was more than a personal tribute; it called attention to a new departure in trade association work, the closer relations established between the technical activities of the cement industry here and abroad. This Mr. Kelley has furthered by promoting visits back and forth between our own and foreign technologists so that the new developments on each side the ocean may be mutually appreciated and applied. Science and industry are not local or national but too much in the past have our technologists had the parochial viewpoint. We can learn from Europe and Europe can learn from us in applied science, just as we are learning in pure science, and the organized industry that realizes this and takes steps to make it effective is on the road of progress.

A New Possibility in Cement

ONE instance of the value of the international co-operation just referred to was offered in the paper on high early strength portland cements presented by Dr. Haegermann, the head of the testing laboratory of the German portland cement association. The facts presented therein should give American portland cement manufacturers much food for thought, and are even more interesting to the user of concrete. In effect Dr. Haegermann said that in Germany the obvious value of a cement which will give a strength in a day or two equal to that of the standard portland at 28 days has been much emphasized by the growing production of various special cements of the alumina variety. These special cements, however, are high in price and their constituent materials fairly rare and scarce. In consequence the portland cement makers have been experimenting, with considerable success, with portland cements of the usual composition and with the standard reactions in all behavior except strength, but which have shown early strengths far above the standard portland and approaching those of the alumina cements. A more detailed description of this interesting development must be left to a later issue, but it is evident that here is shown how Europe is thinking ahead of this country in commercial application of a scientific study which over here has a place in the laboratory but so far has not been transmitted to the user.

Snow Removal

ABOUT this time, as the farmers' almanacs say, prepare to remove snow from highways. There is no joke in the advice. With from 500 to 2,500 miles of road to keep open for traffic all winter, the getting ready for the task is a serious matter to any state highway maintenance engineer. Snow removal, largely, is a motor truck operation and the motor trucks have, all summer and fall, been keeping up the road structure. They require overhauling and to have the snow plows attached and the ballast put in and to be moved to their assigned positions. It is no less task to get the crews assigned and where they can be flung with all their equipment onto the road as soon as the snow call sounds from headquarters. And in making up the crews the relief men are not to be forgotten, for a snowstorm often lasts two or more days and the plows can never stop and the fighting forces must alternate. Similarly there must be arranged replacement parts and repair facilities for the trucks. Snow plowing is heavy work, and the trucks suffer more even than in summer operation, for they may not be spared. There is no more spirited action to witness among all of a great state highway department's activities than that when the snow removal army is called out to battle the storm. In one state this year this army consists of 900 officers and 7,000 men and it doesn't expect to have any vehicle delayed one hour night or day by snow on any mile of over 2,000 miles of highway.

Atlanta's Incinerator Steam Utilized

LIKE most American cities that have built high-temperature refuse destructors of the British type, for years Atlanta found the lure of steam utilization, except for plant purposes, a delusion. This will change on Dec. 1, according to an article elsewhere in this issue.

The earlier Atlanta experience illustrates the continuing inability or unwillingness of American cities to go as far in steam utilization as has been done in England. The difference between the two countries is largely due to the much more extensive municipal ownership of electric light, power and street railway systems in England than in America, thus affording a more ready utilization of incinerator steam there than here. In England a number of municipalities have also utilized this steam in their water or sewage pumping stations—a practice equally open to American cities, except that a smaller percentage of American than of British cities have to pump their sewage.

In America for some years steam from the Savannah refuse incinerator was piped a hundred feet or so to the city water pumping station, while at Milwaukee, a few years after the present incinerator was built, the city began using the incinerator steam for generating electric current which it transmitted two miles for use in driving pumps at the Milwaukee River flushing station. These have been almost the only American instances of the utilization of steam produced by the heat from refuse incinerators.

An early proposal at Atlanta was for the city to generate current at its incinerator for sale to the utility company but the voters failed to authorize the necessary bond issue—less than $100,000—so the utilization plan was dormant until negotiations for the present scheme were consummated some months ago. Should Atlanta sell 100,000,000 lb. of steam—less than half the estimated output—a year at the contract price it would receive $17,200 for what has hitherto been wasted. To class this as clear profit would be fallacious. Even if one ignores the presumably trifling charge necessary to amortize in ten years the city's outlay for connections with the utility company steam mains, as the contract provides, there remains the capital charges on the excess cost of the incinerator plant incurred to produce steam. These have been accumulating for years and, bond charges and depreciation combined, must make up a large sum.

Present-day American practice is to build incinerators to burn refuse rather than to do that combined with producing steam and converting it into electric current. British practice of late is changing, at least to the extent of screening out the fine ash that for decades was generally put through the furnaces. Many of the British plants and also the immense ones dealing with the mixed refuse of Paris, go further and sort out glass, metal, paper, rags, etc., and in some the garbage is separated so it may be shredded and sent with the fine ash to agricultural areas for their improvement.

Centuries of habit are so hard to overcome that very likely British cities will continue to mix their ashes and rubbish and garbage, even now that they are to be separated later. Many if not most American cities, partly due to their backwardness in accepting as a municipal function the collection of all if any of these general classes of waste, can readily compel as much or as little separation of the various classes of waste as investigation by competent sanitary engineers may show to be desirable. No city should decide on this and on a final method of disposal without such an investigation.

Horned Spectacles

NOT every Englishman can be expected to have the information and discernment of James Bryce on American government institutions. It is, therefore, not at all surprising to find our esteemed London contemporary, *Municipal Engineering*, dismiss what it calls "The 'City Manager' Experiment" as not applicable to Great Britain, with the following line of reasoning: "Considering that many American municipalities are notorious for their financial corruption, an honest manager might find that his employers are the greatest obstacle in the way of improvements. Such circumstances, fortunately, do not distinguish the local government of this country, and consequently the idea of appointing managers lacks the only sort of reasons which would justify its adoption here."

We have no quarrel with our contemporary over its unflattering comparison of American and British municipal government, and can excuse it for its offhand assumption that the city manager movement in America rests entirely on municipal corruption instead of being based largely upon a carefully reasoned theory of government resulting from many years of observation and deduction. But after so complacent an observation on the superiority of British over American municipal government it is amusing to find a little further on a veiled attack on the British Ministry of Health. This occurs in the weekly column of animadversions headed "What Some Readers Would Like to Know." The first five of these paragraphs (Oct. 16), raise some very unpleasant questions as to the relationship between certain consulting engineers in England and the Ministry of Health, particularly the departmental engineers.

Such questions here would imply collusion for personal profit or aggrandizement. The questions are equivalent to charging that engineers of the Ministry of Health readily approve plans for sewerage systems "submitted by certain" leading engineers and "turn down plans submitted by 'lesser stars'." One question asks whether the Ministry of Health, "on being requested," supplies "the names of two or three engineers in private practice in Westminster." It is also intimated that plans for unjustifiably costly works are approved if submitted by these favored engineers. Finally, at the close of the fifth question, these words are found: "Moreover, is it quite clear that the [engineering] department should assist in creating a monopoly or in narrowing the circle of engineers whose schemes are favored by the Ministry?"

Possibly our editorial contemporary, before he penned both the note regarding the city managers and his weekly column of animadversions, inadvertently slipped on a pair of "horned spectacles" of British make more or less like those he mentioned in his closing paragraph of queries: "Is not America a country which manufactures new religions, vivid word phrases and horned spectacles, the latter being so ghoulish that they are used by the wearers to frighten nursery children?"

Building Moccasin Creek Penstock, Hetch Hetchy Project

Joints in Welded Pipe 15/16 In. Thick "Laid up" to Clearances Under .007 In. Before Riveting Is Done —Derrick for Placing Pipe Sections Slides up on Pipe Already Laid

MOCCASIN CREEK plant is the first large unit of hydro-electric power to be developed in connection with San Francisco's Hetch Hetchy water project. After coming through the 18-mile tunnel the water will pass down through a 5,000-ft. penstock line, giving a head of 1,315 ft. (static) at the Moccasin Creek power house. The initial installation here consists of four 25,000-hp. double overhung Pelton wheels and provision is made for adding two more units of the same size. Moccasin Creek power house is about 140 miles from San Francisco via the 154,000-volt transmission line which is to be completed by the time the plant is ready for service—probably about March next year.

The four units now being installed in the power house will be served by eight nozzles fed by hammer forge welded steel pipes, 36 in. in diameter. Some 100 ft. from the nozzles each pair of 36-in. pipes join in a 54-in. welded line. The four penstocks thus formed continue as welded lines to the crest of the hill at which point each diameter is enlarged to 66 in. Here the four welded pipes terminate in two 104-in. riveted steel lines that extend the remaining distance of about 2,000 ft. on a comparatively easy grade to the surge chamber. At the surge chamber a thimble and butterfly valve is installed for a third 104-in. connection to supply the two generating units that are to be added to the power house later.

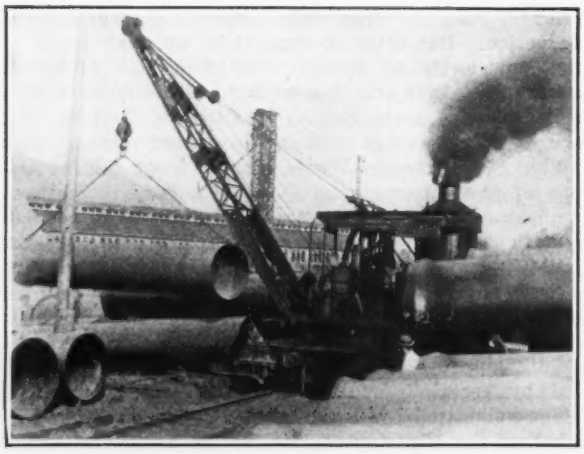


FIG. 1—LOADING PIPE AT THE FOOT OF THE INCLINE

Under the power house floor and for the first 350 ft. outside the building all the penstocks are laid in trench and encased in concrete. These pipes and all the penstock lines up the hill as far as the connection with the two 104-in. riveted lines are welded steel, the thickness varying from ½ in. at the power house to ⅝ in. at the upper end. Much of this line is on a steep grade, the maximum being about 63 per cent.

Throughout the entire length of the welded pipe each section is supported on a concrete saddle, carefully set to grade before the erection of the penstock started and shaped on its upper surface to fit the curve of the pipe. These saddles were brought up to grade only for a width of 8 in. in the center or bottom of the curve, the remainder of the surface being left about 2 in. below contact with the pipe, thus allowing space in which to grout the pipe after riveting and testing had been completed.

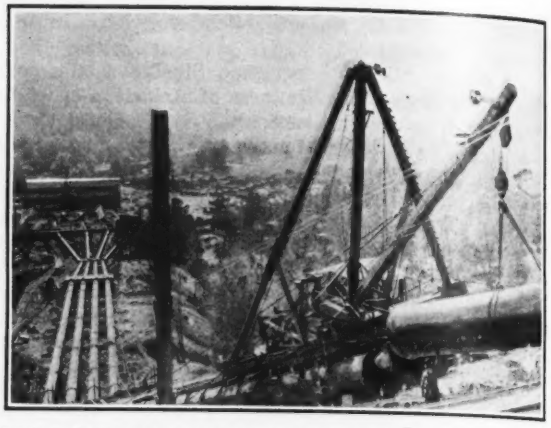


FIG. 2—DERRICK IN OPERATION ON PIPE ALREADY LAID
Note the cables used to fasten skid timbers to penstock. The long leg of the derrick has a goose-neck at the top and splices vary its length.

Massive reinforced-concrete anchors were located at each of the eighteen changes in grade or alignment and copper-plated expansion joints were placed in each penstock line between each pair of anchors. In some cases the anchors are only 90 ft. apart and from this the distance ranges up to 1,000 ft. as a maximum. Foundations for the anchorages were poured at the same time as the concrete saddles for each pipe section and after the pipe lines are laid in the anchor cradles the upper part of the concrete is poured, bond being provided by reinforcing bars left projecting from the foundation concrete.

Pipe sections for the entire penstock line were delivered by rail to a large material storage yard on the flat adjoining the power house. A locomotive crane operating on spur tracks through this storage yard picks up the sections as they are needed in the line and delivers them to a flat car operated on an incline track alongside the penstock.

This tramway, operated by a 300-hp. electric hoist at the upper end, has a capacity of about 16 tons. In hauling up the pipe sections, the heaviest of which weigh about 16 tons, a short length of 1¼-in. cable attached to the main hoisting cable close to the car is passed through the pipe section and into a hook clamped to the lower end of the section. Thus the pipe section is held securely even in the event that the car leaves the track or the pipe section rolls off.

When a section is taken up the pipe line to a point where the work is in progress it is lifted from the car and delivered to place by a derrick resting on the portion of the penstock lines already secured in place. This stiff-leg derrick is supported on a platform mounted on skids and is moved up the pipe line over 10x10-in. skid timbers fastened to the penstock pipe.

These skid timbers have heavy eyebolts near each end on the under side, and each timber is long enough

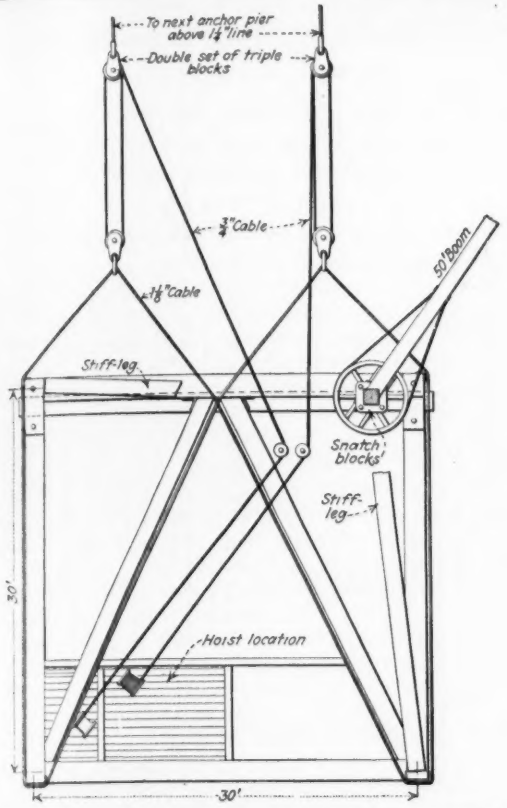


FIG. 3—DOUBLE BRIDLE OF 1⅛-IN. CABLE FOR MOVING AND HOLDING DERRICK

to extend over two of the four penstock lines. When the timbers are placed in the proper position a 1-in. cable is passed from the eyebolt on one end of the timber under the two penstock lines to a corresponding eyebolt on the other end. A turnbuckle and hook slung from an eyebolt in the center of the skid timber is then used to draw the cable up between the two pipe lines until there is enough tension in the cable to clamp the timbers firmly to the pipes. Five to seven of these timbers on each pair of pipe lines provide a well secured foundation on which to slide the derrick platform. Enough skid timbers are provided so that when the derrick is ready to move forward for its full length the necessary timbers can be fastened in place and the move made, after which the timbers just left are removed and stored awaiting the next advance.

The derrick platform itself is 30 ft. square and is made of heavy timbers well braced and reinforced with transverse steel rods. It is equipped with a 32-ft. mast and a 50-ft. boom operated by a 35-hp. motor and a double-drum hoist. Much of the lesser shifting and pulling required is done with Manila rope operating over the two gypsies with which the winch is provided.

The mast and one of the stiff-legs of the derrick are on the forward or upper edge of the platform where they are mounted on an 18x18-in. timber extending entirely across the platform and turning in wooden bearings which are clamped around rounded ends of the timber. This timber constitutes the hinge of the derrick and makes it possible to keep the mast vertical or as nearly so as is desired, regardless of the change of slope. The mast foot-block is arranged so that the mast can be brought to the desired angle with relation to the platform by jacking up and blocking beneath it.

The other leg of the derrick is arranged to adapt itself to any slope which necessitates a changeable angle at the top and a variable length of the leg itself. This is accomplished by a hinged goose-neck at the top of the mast, shown in the accompanying sketch, and a splice in the lower end of the leg in which the substitution of timbers of different lengths will plumb the mast on any slope.

The support for the winch is also kept level by means of a steel rod along its upper edge which serves as a hinge to attach the winch support to the derrick platform proper. The winch supports are placed at the desired level and blocked there at each change in slope. Thus it is apparent that the main platform or timber frame of the derrick remains parallel to the slope of the penstocks, whatever the angle may be, and the winch supports are leveled and the derrick mast plumbed by movement about the respective hinges. The derrick mast, in fact, is always kept leaning forward a foot or two from the plumb position, thus making the low point in the swing of the derrick boom on the uphill side of the platform as a whole, this feature being an assurance against overturning in case the tackle should break or the loaded boom should swing free from any cause.

The derrick platform is moved uphill by two sets of blocks attached at the upper end to penstock anchors and at their lower ends to a 1⅛-in. cable passing entirely around the derrick platform and diagonally across as shown in the accompanying sketch. When the derrick is in position for handling pipe sections, this tackle is held rigidly in place by wire rope clips which attach the hauling line to one of the other lines

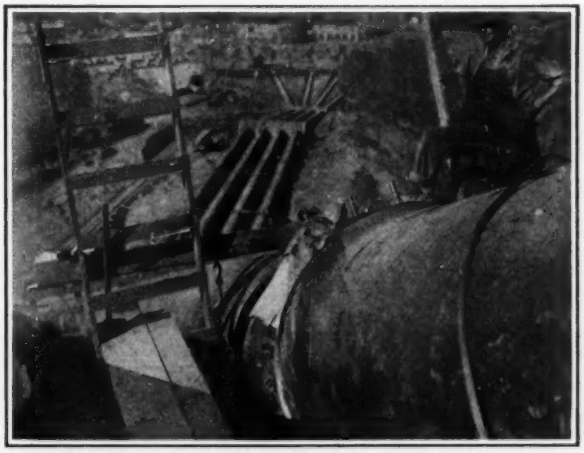


FIG. 5—A VAPOR TORCH HEATING UP A JOINT
The entire circumference of each joint was heated, 18 in. at a time, and "laid up" to close clearance.

near the upper blocks. To prevent any danger of tilting or overturning the platform when the boom is swung to one side, cables are passed under all four penstock lines and attached to the derrick platform on either side near both the forward and the rear ends, these lines being drawn up taut by means of hooks and turnbuckles.

With this rig it is a simple and speedy operation

to pick up a pipe section from the incline car, swing it to position in the penstock line and rotate it enough to permit placing a few bolts through the rivet holes to secure it in position. It was found inadvisable to attempt to use the bull-wheel for swinging the derrick boom. Instead a line is brought from a dead-man on the side of the penstock opposite the incline and one of the gypsies is used for pulling the boom into the desired position.

A very high standard of excellence has been established in making the field joints on this penstock line, the requirement being that before any riveting is done, the two plates to be riveted shall be laid up so that a steel feeler 0.007 in. in thickness cannot be slipped in between them at the rivet line. This standard of workmanship was adopted by the master mechanic, James Devine, on the ground that when the joint is well laid up leakage does not develop in the event of high stresses due to temperature changes or to water hammer, and that this advantage warrants the extra

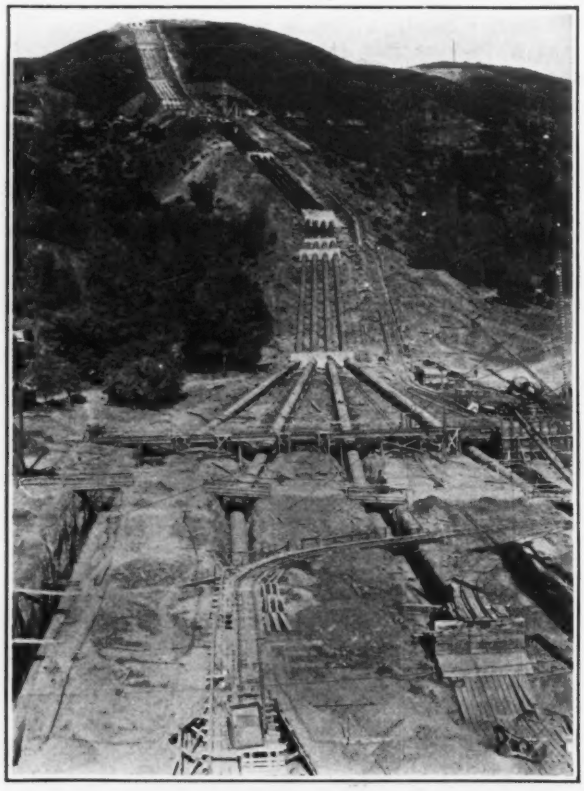


FIG. 4—PENSTOCK LINE LOOKING FROM THE POWER HOUSE

Beyond crest of hill is surge chamber whence the 104-in. riveted pipes bring water along far side of ridge to top of the steep slope shown.

cost of adopting "marine specifications" for these field joints.

As all of the field joints in the welded pipe line were individually fitted together in the manufacturer's shop and drilled in this position, this close fitting is a relatively easy matter requiring only a small amount of heating in the field. The field heating is accomplished by applying a kerosene vapor torch to about 18 in. of the joint circumference at a time and then using the sledges on this much of the circumference to "lay up"

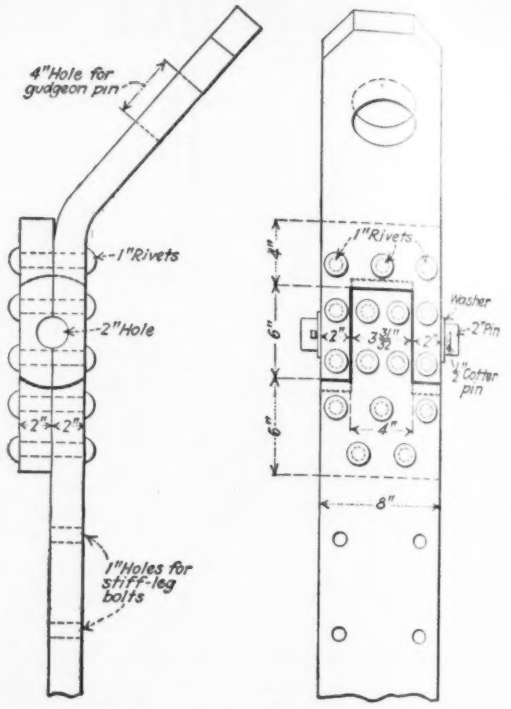


FIG. 6—GOOSE NECK OR HINGE JOINT AT TOP OF MAST

the metal of the outer section closely against the inside section. Laying up the joints in this way requires a crew of four men, three on the outside using torch and sledges and one on the inside to pass the bolts through. Where the plate thickness is about one inch, this crew can lay up about one or two joints per day, according to conditions.

Before riveting commences all holes are reamed to a diameter $\frac{1}{16}$ in. greater than the rivet shank. At all angle points rivet holes in the outer pipe were not drilled in the shop but were left to be drilled after the pipe had been fastened in position. Several holes were always drilled in advance in such blanks to permit bolting them in place until the riveting was done.

M. M. O'Shaughnessy is city engineer of San Francisco and W. A. Kraner as superintendent of construction has had general charge of the installation of the penstock line for the city. The welded pipe was supplied by the M. W. Kellogg Co. and the riveted steel pipe by the Western Pipe & Steel Co.

Ymuiden Lock Work to Go On

In *Engineering News-Record*, Sept. 25, 1924, p. 510, in E. J. Mehren's article on "Holland's Post-War Difficulties," it was stated "The building of the great new lock at Ymuiden has practically been postponed, though some small parts of the work are going on." Since that was written there has been such amelioration in the economical and financial situation in Holland that the government has resolved to advance with more speed the scheme of the construction of this new lock. In accordance therewith, in December, 1924, bids are to be requested for the construction of a portion of the lock at an estimated cost of 3½ million guilders ($1,400,000 at the present rate of exchange).

Emergency Pumping Plant Saved Irrigation Crops

Lake Tahoe Water Supplied to Truckee Valley Farms by Pumping Over Outlet Bar—Dragline Engines Requisitioned

By H. F. McPhail

Engineer, Bureau of Reclamation, Denver

DUE TO the extremely light rainfall in the Sierra Nevada mountains in the winter of 1923-24 the flow of water in the Truckee River fell to such a low point that water was no longer available through the Truckee Canal for use on the Newlands project. Lake Tahoe, where the Truckee River heads, fell to such a low elevation that only about 100 sec.-ft. would flow naturally from the lake into the river.

Legal objections raised by riparian owners and the California authorities made it impossible to excavate the outlet of the lake so that an increased flow could be maintained from the lake into the river. For this reason it was found necessary to install a pumping plant in the lake which would pump the water needed for irrigation into the river channel.

Much valuable time was lost in waiting for sufficient rainfall to carry the farmers through the season without serious loss of crops, before final decision was made to install the pumping plant. When this decision was reached only a very few weeks were left in which to make this installation in time to save the farmers. A contract was made with the Latourrette-Fical Co., of Sacramento, to install and operate this plant. This company made exceptional progress with the work, and within twenty days from contract date the first two pumping units were in operation.

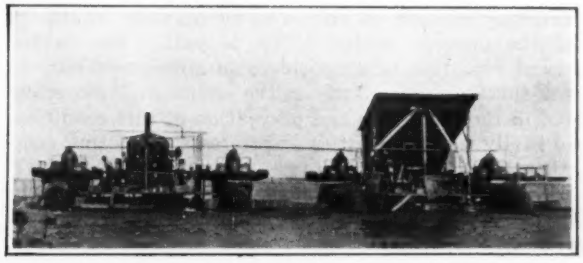
Each pumping unit was a 175-hp. gas engine direct-connected to two 36-in. centrifugal pumps. The engines available were those of dragline excavators used on the Newlands project, while the pumps were part of a plant near Williams, Calif., formerly used to pump water for the cultivation of rice. The engines were removed from the draglines and shipped through Sparks, Nev., being delayed long enough for all necessary machine work in connection with equipping them for direct connection to the pumps to be done at the Southern Pacific shops.

Each engine and each centrifugal pump weighed approximately ten tons. At Truckee, Calif., the machinery was transferred from a standard-gage railroad to the narrow-gage railroad running to Lake Tahoe. At Lake Tahoe the contractor was fortunate in finding available a track which ran out into the lake so that the material was transferred easily from cars to barges.

The units were set on cribwork foundations with bases of 12 x 24-in. timbers and crisscrossed to the proper elevation by 12 x 12-in. timbers. These timbers were weighted down with sacks of gravel at a point where the bottom of the lake was fairly flat and the depth of water about 4 ft. The engines and pumps were slid off onto the cribbing directly from the barges. A small 15-hp. gas engine was also mounted on the cribbing, to operate a vacuum pump for priming as well as to start the main engines by a belted connection.

A sack dam was constructed from the shore of the lake to the pumping plant and from there along the center of the Truckee River downstream to an elevation where it was believed the back water caused by the pump discharge would not cause a return flow into the lake. This was done in the hope of being able to preserve what little natural flow there was from the lake. However, when it was found that the flat profile of the river made it impossible to preserve this flow, the dam was extended across the river to the opposite shore of the lake so as to form a dam completely across the river mouth. The material for the sack dam had to be brought to the lake about two miles by rail and truck.

Suction and discharge pipes for the pumps were constructed of sheet steel and were so shaped that their



PUMPING PLANT THAT SAVED TRUCKEE VALLEY CROPS

mouths were submerged on both sides of the pump to allow for priming by means of a vacuum pump and also to preserve all siphon effect possible.

The operation of the plant has been very successful, and about 220 sec.-ft. has been pumped into the river throughout the irrigation season.

Tests for Corrosibility of Water

Extract from paper presented to Pennsylvania Water Works Association by J. W. Ledoux, Consulting Engineer, Philadelphia, Pa.

ALL WATERS that cause tuberculation of cast-iron pipes are corrosive in action and all such corrosibility is increased enormously with the temperature of the water. For instance a water which is noticeably corrosive at boiling temperatures is much more so at the usual boiler temperatures. A simple proposition would be to test the corrosibility of the water at say 300 deg. F., and, if found corrosive at that temperature, apply such a remedy as would render the water neutral and free from corrosibility. That proposition sounds simple enough but in the writer's experience he has not found to exist any practical application of that principle.

Samples of water whose relative corrosibilities are to be determined under all conditions are first analyzed for iron, and then placed in strong 2-oz. bottles with large mouths and glass stoppers. In each one of these is submerged a given amount of pure iron, a given length and gage of piano wire in coil being suitable. The bottle is then placed in a pressure clamp and heated to a temperature of 300 deg. F., which is maintained for 20 minutes. After being cooled gradually the water is again tested for iron, the amount of which will indicate with certainty the relative corrosibility of each of the samples of water.

There are two methods of producing this temperature: One is to heat ordinary machine oil in a pot large enough to hold ten to twelve samples; the heating may be done by a gas flame or an alcohol lamp. The second method is to place a closed receptacle in a valved by-pass of a steam pipe. This receptacle may be made with a flange cover and have side outlets. Several bottles of water, each with its pressure clamp, can be placed in the receptacle and removed after being cooled. No thermometer is needed because the boiler steam is generally above 300 deg. F.

It is easy to obtain bottles with flat glass stoppers that will not break when heated, and it is important that bottles should be completely filled with water before placing in the receptacle. It would seem to the writer that this method of testing is much simpler, more reliable and superior to any method of determining the hydrogen-ion concentration, the conclusions from which are at best conjectural.

Shoving of Asphalt Pavements Is Over-Criticised

Many Black-Top Roads Are Not Asphalt—Shoving Only Occasional in True Asphalt—Stability Test for Asphalt Mixtures

By Prevost Hubbard
Chemical Engineer, The Asphalt Association, New York City

During the past few years uneven contour or waviness in bituminous pavements has received an increasing amount of attention by highway engineers and the general public. This is partly due to the present condition of a considerable mileage of our old black-surface roads, partly to the efforts of those interested in the correction and prevention of this condition, and partly to the activities of interests promoting competing types of pavement.

Unfortunately the term asphalt has been very loosely and incorrectly used in descriptions or discussions of pavements which have shoved under traffic. The layman and usually the engineer, except where he has contrary information regarding individual cases, classifies all black-surface roads as asphalt. As a matter of fact a very considerable proportion of such roads, particularly those which have become wavy, are not asphalt at all but consist of macadam or gravel with a cheap surface treatment or carpet of oil or tar and stone chips. There are also many miles of old, poorly constructed bituminous macadam pavements laid upon wholly inadequate foundations which have become wavy due either to uneven settlement of the foundation or faulty construction. Moreover many such pavements have been constructed with a tar binder and not with asphalt.

When riding over these black-surface roads the layman, even if he realizes that everything black is not asphalt, has no means of distinguishing asphalt from the other types. Even the engineer is frequently unable to identify the type unless he digs into the pavement surface. As a result asphalt pavements have, to an entirely unwarranted extent, been criticised for their tendency to shove.

No type of pavement is perfect. All have their faults. For example, cracking appears to be an inherent fault of all rigid monolithic pavements, which engineering skill has so far been unable to eliminate. On the other hand, displacement or shoving under traffic while one of the most serious faults of asphalt pavements is not an inherent characteristic as evidenced by millions of square yards of satisfactory asphalt surfaces varying from one to forty years of more in age and subjected to all conceivable conditions of exposure and traffic. It is rather to be considered as an occasional manifestation which in many cases is localized to very limited areas in an otherwise satisfactory pavement. Except where failure of the foundation is evidently responsible, comparatively few cases are to be found where a high percentage of the wearing course even in the direct line of travel has shoved.

Asphalt Paving Defects—Service results over a long period of time have demonstrated that it is quite possible to construct an asphalt pavement which will not shove under the most severe climatic and traffic conditions but it must be admitted that our present knowledge of how to accomplish this is not as complete as it should be. It is well known that there are a number of conditions which tend to promote shoving which may be classified as follows: (1) Foundation faults, (2) construction faults, and (3) inferior paving mixture.

In addition to the above, shoving may result from certain exterior causes such as softening of the pavement by an excess of oil or gasoline drippings from standing automobiles or by gas leaks from mains below the pavement structure.

Among the items listed, foundation faults cannot be charged to the asphalt pavement proper. Construction faults are quite common but are well understood and are readily eliminated when their importance is fully realized. It is undoubtedly true that foundation and construction faults, together, are responsible for a very large proportion of the shoving failures which have occurred in asphalt pavements and that their correction or elimination is of the utmost importance in future paving work. At the same time it is recognized that in many cases the paving mixture has been to blame and that the problem of insuring the use of mixtures which are most highly resistant to displacement is an important one.

Most of our specifications for asphalt paving mixtures are now filled with arbitrary limits which when met have in the past insured reasonably satisfactory results

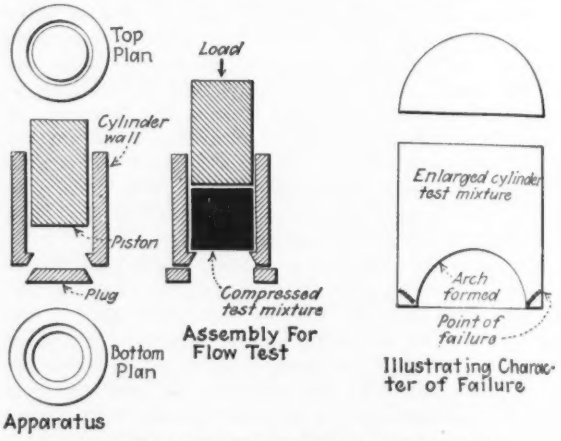


FIG. 1—DEVICE FOR TESTING STABILITY OF ASPHALT MIXTURES

but which cannot be modified or improved upon to meet changing traffic conditions without becoming purely experimental. Traffic conditions today are so entirely different from those prevalent when our older pavements mere constructed that it is quite reasonable to assume that the former ideal paving mixture is not necessarily the best to use at present, although our present specifications are largely based upon the earlier types of satisfactory pavements.

In attempting to prevent shoving in modern paving mixtures, several modifications of former practice are finding favor including the use of more mineral filler, relatively less asphalt and the use of harder grades than were previously thought most desirable. No accepted method of determining the limitations of such modifications nor their interrelationship has, however, been devised, and the same is true regarding modifications of our arbitrary limits of mineral aggregate grading.

Test for Asphalt Stability—It has long been recognized that great need exists for some suitable labora-

tory test to determine the stability of asphalt paving mixtures and at a recent conference on asphalt pavements the writer described the first stages of an investigation which he had started with the idea of developing a simple laboratory test which could be made available for use not only in testing laboratories but at paving plants so as to enable the engineer and contractor to adopt a formula with available local materials which would insure the maximum stability of the mix which it was possible to obtain. It is believed that the following brief summary of this investigation will be of interest to highway engineers, as illustrating attempts which are being made to increase our knowledge of paving mixtures and more nearly perfect our asphalt pavements.

The apparatus which has so far been used consists of a cylindrical steel mold with an internal diameter of 2 in. equipped with a snug fitting plunger, as shown in Fig. 1. The bottom of the mold has a circular beveled opening smaller than the internal diameter thus producing a shoulder which holds the specimen in place. This opening may be closed with a beveled plug when preparing a specimen for test. The test itself consists in placing about 210 grams of hot loose paving mixture in the preheated mold with the bottom closed by the plug. The plunger is then inserted and the sample

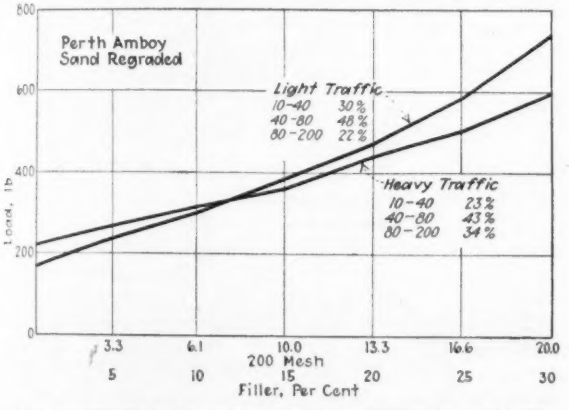


FIG. 2—EFFECT OF INCREASING AMOUNT OF FILLER

compressed under a standard load to produce a cylindrical briquet 2 in. in diameter and approximately 2 in. high. The mold containing the test specimen is then brought to the desired temperature of test, the bottom plug removed and load applied on the plunger until the bond in the mixture is broken and it begins to exude from the bottom opening. The exact load required to break the bond is reported as a measure of the resistance of the mixture to displacement.

During the early part of the investigation it was realized that it would be highly advantageous to secure some idea of the relative stability of various mineral aggregate gradings irrespective of the effect of the asphalt which is used as a binding medium. Further study showed that by substituting 10 per cent of castor oil for the asphalt cement such comparison was made quite possible. A quantity of Perth Amboy sand, which is extensively used in asphalt paving in New York City, was obtained and from this supply sands of various mesh composition were prepared by screening and recombining. When mixed with 10 per cent castor oil, compressed and tested in the mold these sands showed very considerable differences in their ability to resist displacement. Mineral filler was then added to the sands in increasing amounts and its effect upon the stability of each sand product was determined.

From the results obtained diagrams were constructed

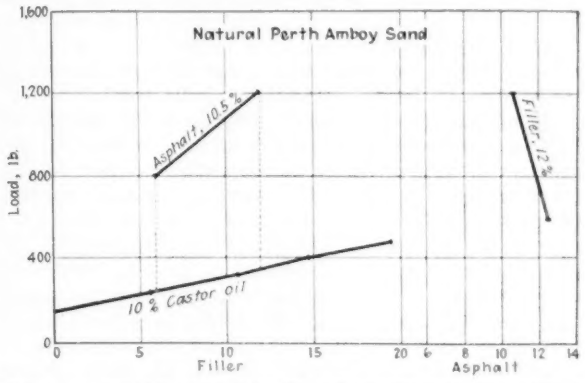


FIG. 3—ASPHALT AND CASTOR OIL MIXTURES COMPARED

showing the load causing failure for each sand grading tested, as the percentage of mineral filler in the mixture was increased. It was found that the addition of filler invariably increased the stability of all of the sands investigated irrespective of their grading. A comparison of the results obtained with different sand gradings brought out some very interesting relationships. For instance, it was found that what we had previously considered as an ideal light traffic grading gave higher results than the generally accepted heavy traffic grading when over 12 per cent limestone dust filler was added to each, as shown in Fig. 2. It also appears that our specification limits for the grading of asphalt sand, while safe, are too restrictive, as a number of sands which failed to come within the usual specification limits showed higher stability values when mixed with 15 per cent of mineral filler than those sands which met specification requirements. The castor oil test furthermore gave promise of being able to distinguish between sands of the same mesh composition, the grains of which, however, differ in surface texture and shape.

Most of the preliminary work was devoted to a study of mineral aggregates only, but the test was developed sufficiently to indicate that it would prove satisfactory for studying mixtures of mineral aggregate with asphalt. The few asphalt tests which have been made show interesting comparisons with the castor oil tests as illustrated in Fig. 3. In this illustration the lower black line shows the stability value obtained from natural Perth Amboy sand in a castor oil mix with various amounts of limestone dust filler. Directly above it appears a line indicating the results obtained with the same sand mixed with from 6 to 12 per cent filler and 10.5 per cent asphalt. The great increase in stability due to the presence of the asphalt cement is at once apparent. In this connection it is of particular interest to note that the addition of filler to the asphalt mix materially increases its stability as in the case of the castor oil mix and that the relative increase is almost directly proportional. It will be highly desirable to ascertain whether such a direct relation is to be expected in other comparisons.

In the illustration at the right is shown the effect

of varying the percentage of asphalt in admixture with the same sand carrying 12 per cent of limestone dust. The marked decrease in stability due to increasing the asphalt from 10.5 to 12.5 per cent is at once apparent. Thus an increase of asphalt of 2 per cent over what might be considered as the normal amount has cut the stability value in half. The great importance of ascertaining the correct amount of asphalt for a given mineral aggregate and then holding this amount within very narrow limits is thus plainly indicated.

Relation of Test to Practice—While the investigation has not been carried sufficiently far to attempt to develop definite theories or to interpret the test results too literally, it is felt that a method has been devised which if intelligently used will make it possible to secure a vast amount of information leading to the development of more stable asphalt pavements. The test gives promise of furnishing valuable data on many questions relating to asphalt paving mixtures which heretofore have been matters of individual opinion or purely arbitrary treatment. Among the most important of these are:

1. The importance of sand grading requirements and the rational limitations of such requirements which should be adopted.
2. The relative value of different kinds of mineral filler, such as limestone, slate, silica, hydrated lime and portland cement.
3. The proper proportioning of asphalt with different mineral aggregates to secure adequate resistance to displacement.
4. The effect of consistency and other properties of asphalt upon the stability of paving mixtures.
5. The possible adoption of definite stability limits of paving mixtures as determined by test which will undoubtedly allow a much wider use of available local materials and thus tend to reduce the cost of asphalt pavements and at the same time insure greater stability.

Spanish Northern Ry. Electrifies Part of Its Line

ELECTRIFICATION of the most difficult operating section of the single track line of the Spanish Northern Ry., the 38.5-mile section between Ujo and Busdongo, is now about completed according to *General Electric Review*. This portion of the railway is largely on a 2 per cent grade in a mountainous country where curves are sharp and tunnels numerous. There are 71 tunnels in all with an aggregate length of over 16 miles.

The initial contract for the electrification provides for six 3,000-volt locomotives, two 2-unit 3,000-kw. substations and overhead line material for the complete outfit. Subsequent contracts have been let for six more locomotives.

The locomotives of the original contract weigh approximately 90 tons, have six motors geared to the six driving axles and exert a tractive effort of 22,000 lb. at a speed of 22 m.p.h.

The locomotives are designed for regenerative braking and have vacuum brakes for stopping.

Power is received from the hydro-electric system of the Electra de Viesgo Co. at 30,000 volts and is converted to 3,000-volt direct current at the two substations.

Cable-Operated Pontoon Bridge Over Chicago River

Temporary Draw Span Completes Important New Thoroughfare—Safety Barrier Protects Highway Traffic

A PONTOON drawbridge which, when closed, is a fixed truss span, has been installed at Chicago for a temporary crossing of the river to form a link in the Ogden Ave. extension until such time as the city has funds available for the bascule bridge already designed. This new thoroughfare is an important improvement, extending diagonally across the northern part of the city and, with the older southern part of Ogden Ave., providing a direct route between the southwest and northeast sections, keeping clear of the business district. In order to open communication as early as possible, a slight detour was made to a temporary

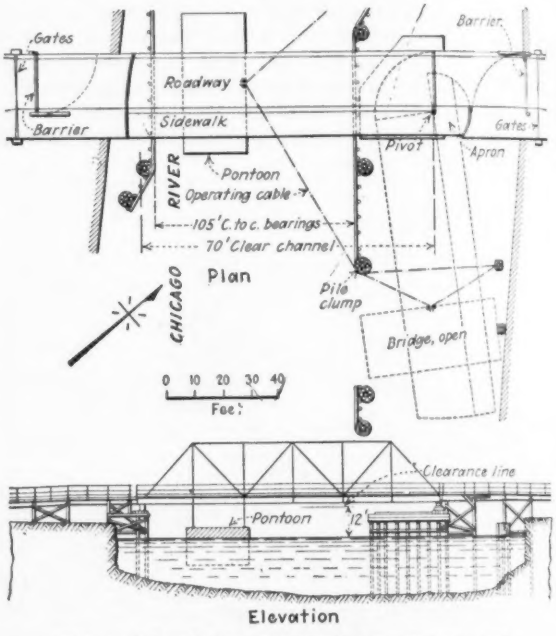


FIG. 1—PONTOON DRAWBRIDGE AT CHICAGO

bridge site just below that of the permanent bridge and its approaches.

The temporary Chicago River bridge consists of a 105-ft. second-hand riveted through truss span over the channel, with pile and timber trestle approaches, Fig. 1. When the bridge is closed, both ends of the span rest on timber bents. At the pivot end, one truss is supported on a ball-and-socket seat, while the other has a roller carriage riding on a curved track. At the opposite or free end, there is under each truss a skid timber which rests on the fixed supports. Under this free end is a steel pontoon 50x22 ft. and 13 ft. deep, shown in Fig. 2. A steel bent riveted to the bottom chords of the bridge trusses at a panel point has its posts slipping inside sockets on the pontoon. Pumps and sea valves provide for handling water ballast, so that by pumping out the water the pontoon will rise and lift the free end of the span, the bridge being then swung round on its ball-and-socket pivot to provide a clear 70-ft. opening for navigation.

For swinging the pontoon and bridge, a motor-driven propeller was at first proposed, but the arrangement adopted consists of two ¾-in. cables anchored to pile clusters above and below the bridge, with the free ends of the cables handled by a 50-hp. double-drum motor-driven hoist on the pontoon. This hoist, which can exert a pull of 10,000 lb., hauls in one cable while paying out the other, thus pulling the span to its open or closed position.

Two vertical-shaft centrifugal pumps with bevel-gear drive from motors, can lighten the pontoon so that in half a minute it will lift the span from its end bearings. When the span reaches its closed position, the sea valves are opened to flood the main compartment, thus lowering the pontoon and leaving the span seated on its fixed supports. Watertight compartments at each end provide sufficient buoyancy to keep the structure afloat in case the sea valves should be opened accidentally while the span is open or being swung. An operating cabin is placed at one end of the pontoon and is heated by steam radiators served by a small boiler.

Safety Barrier Gate—Since this temporary bridge cannot be equipped with the gates and safety devices of a permanent structure, the ordinary roadway gate or vertical swinging arm on each approach is supplemented by a 10x10-in. yellow pine timber which is swung across the roadway about 2 ft. above the paving and in this position its ends rest in a heavy timber frame on each side. This barrier is shown in Fig. 3. Under the free end of the 10x10-in. timber is a roller which rides on a beveled path in the frame at the farther curb line, raising the timber slightly as it approaches the end of its travel. In reaching this position, the barrier timber also raises a hinged lock consisting of a short hinged wooden block which then drops back into normal position. Should the timber be struck, its free end will yield or travel about 18 in. before it is held by engaging the lock. An electrically operated latch lifts this lock when the bridge has been closed and the barrier is to be swung clear of the roadway. The barrier timber is mounted on a vertical shaft geared to an ordinary motor-operated gate stand placed as shown in the drawing, below the deck of the approach.

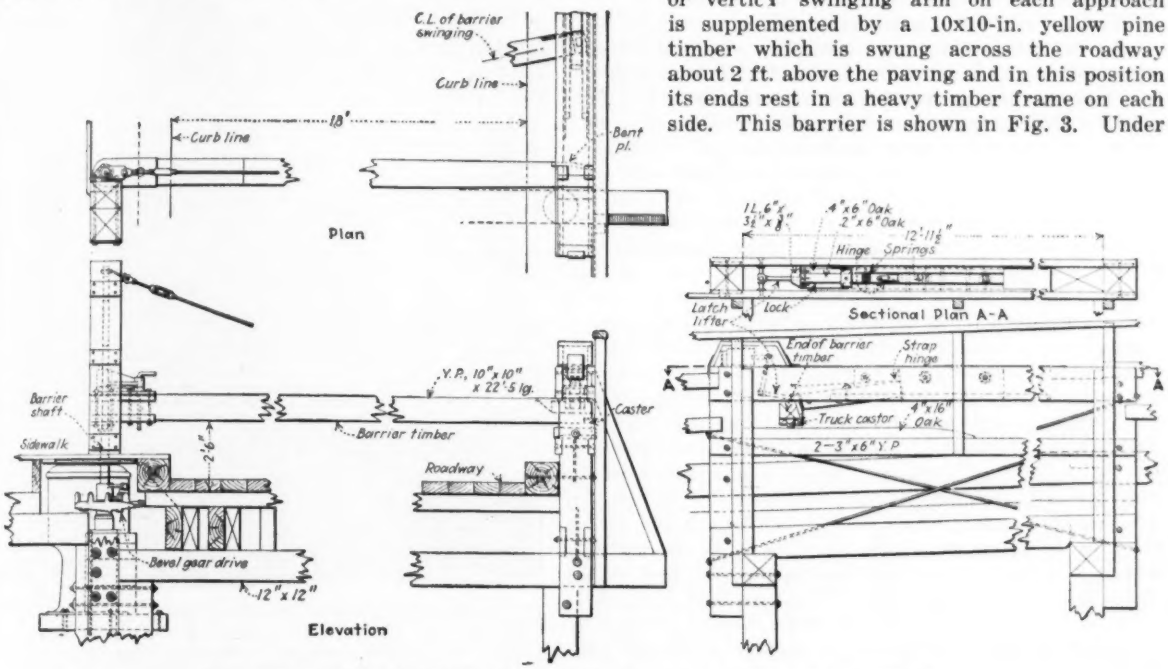


FIG. 3—BARRIER TO STOP AUTOMOBILES ON DRAWBRIDGE APPROACH

The opening or closing of the bridge can be done in 1½ minutes, as required in the permit from the United States Government.

This cable-operated pontoon bridge was designed in the bridge division of the Department of Public Works, under John Ericson, city engineer; Thomas G. Pihlfeldt, engineer of bridges; and Donald N. Becker, engineer of bridge design. Erection by the construction division of the Bureau of Engineering was in charge of J. J. Versluis, engineer of construction. The cost of the entire structure, including approaches, was about $125,000, while the lighting and paving on the detour leading to it brought the total cost to about $200,000.

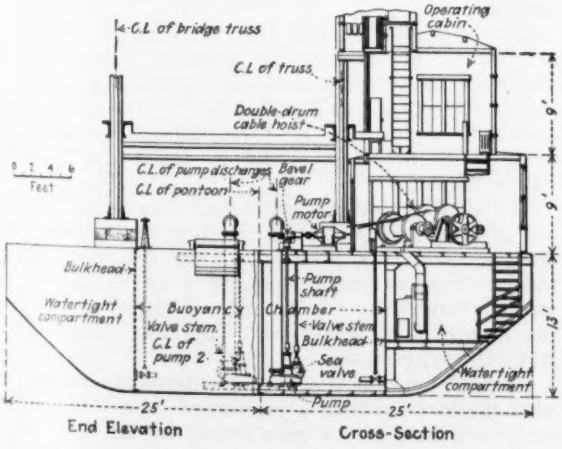


FIG. 2—PONTOON FOR OPERATING DRAW SPAN

Wembley—Advertisement for the Empire and Engineering

Exhibition Structures and Engineering Exhibits Show the Worthy Part Played by the Engineer in Success of Wembley—Sir E. Owen Williams was Exhibition's Engineer

By E. J. Mehren
Vice President, McGraw-Hill Co., Inc.

"TOUR the Empire at Wembley"—so read the bus, "Underground" and railway advertisements tempting people in London to go to the British Empire Exhibition. And well is the slogan chosen. The British Empire *is* at Wembley. One can visit in a day such far-flung possessions as Hong Kong, British Guiana, India, the Gold Coast, and Newfoundland. He can lunch in Australia, have tea in Canada, and dine in South Africa. He can go from the rather ordinary displays of food products made in England, to exhibits of the craftsmanship of India, and later revel in the "spicy Eastern smells" of the Burmah pavilion.

It is a great advertisement, showing the Empire's marvelous variety of products and the possibilities of intra-Empire trade.

"Master Advertiser"—Indeed, John Bull has earned this summer the sobriquet of "Master Advertiser." Every great exposition is necessarily an advertisement of the country wherein it is held. But John went a step farther. He cannily restricted display in his exposition to his own family, but then when he had gathered the resources of all his far-flung lands, he invited not only his own to come and see, but all the rest of the world as well. It was as if he had slyly said, "I'll pretend that this is a family party, but I want the outsider to get an impression of the might of my Empire."

And he has succeeded.

Not only did his own people come, but foreigners as well. To make sure they would come, John's advance

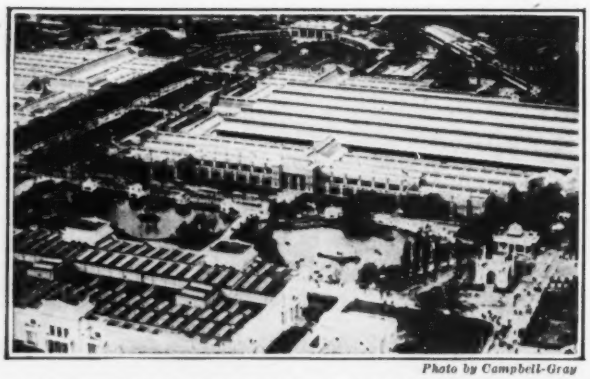


Photo by Campbell-Gray

AIR VIEW OF PART OF BRITISH EMPIRE EXHIBITION
The building in the center is the Palace of Engineering, the largest structure in the Exhibition.

agents scoured the world and got international conventions in great number to hold this year's meetings not merely in London, but within the very gates of the Exhibition itself. Successively there were held, for example, the World Power Conference, the convention of the Associated Advertising Clubs of the World, and the special meeting of the American Bar Association, all of them—the last two, particularly—drawing large numbers of Americans to London. In addition, the usual summer stream of Americans was much augmented this year and a large proportion routed through London by the alluring accounts of the Exhibition. Likewise there were strong streams of visitors from the Continent.

Photo by Campbell-Gray

PALACE OF ENGINEERING—WITH CONCRETE BLOCK WALLS
This, the largest building at Wembley, has an area of 650,000 sq.ft., and maximum plan dimensions of 750 by 1,000 ft.

And John treated them all with the best of British hospitality. To those attending conventions, his hospitality was, in fact, overwhelming.

He got what he was after—if he wanted to show foreigners the strength of his Empire—and he fully deserved all the advertising he got.

Needless to say, the show was a good one. It was a fine educational institution, deserving days of close study. To review it adequately would take many pages. The present purpose is to give merely a general impression of the Exhibition, and to touch upon its engineering side.

General Features—But first let there be mention of a number of outstanding general features: His Majesty's Government Building, the Australian Building, and the Canadian Pacific exhibit. Too much praise cannot be lavished on all three, though the first two, as is to be expected, outdid in extent the Canadian Pacific display.

The British Government exhibit was a well-worked-out presentation of the activities of the Imperial and Home governments, brought to a focus in the center of the building, as one entered, by a clever map of the world whereon, by the flashing of lights, facts about the Empire were displayed. This was, deservedly, a crowd-drawing feature.

Cleverly, too, was it set. One entered the building on what might be termed a mezzanine floor. At once, at one's very feet, on the floor below, lay this great map, the land areas a relief built of glass, with colorings appropriate, respectively, to the deserts, the humid lands,

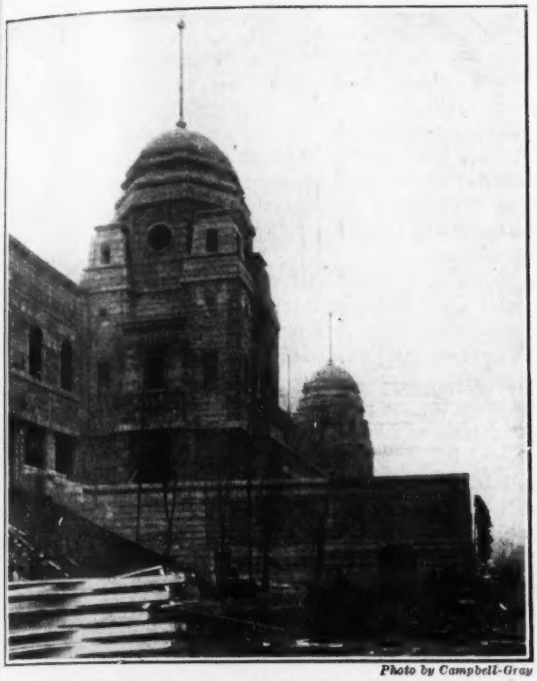


Photo by Campbell-Gray

THE STADIUM—A MONOLITHIC STRUCTURE
Variations in the tone of the concrete were secured at the corners by half-inch beveled strips attached to the forms.

and the mountain areas. In between was water, the oceans and seas, across which plied little ships on the standard trade routes of the world.

As one watched from his balcony post, patches of red appeared on the map, illumined from below, and a lantern slide projection on a convenient screen informed one that the patches showed the countries of the Empire at the time of Queen Elizabeth. A pause, and then a new pattern in red—the Empire in the year 1700. Then the Empire just before the American War of Independence, again the Empire of about one hundred years ago, and finally the Empire of today, a mighty splashing of red, capping the North American continent, extending down Africa from the Mediterranean to the Cape of Good Hope (an astonishingly large area of that mighty continent), a swath across the lower part of Asia (the Indian Empire), Australia and New Zealand, with little dots of light everywhere—Britain's outposts on the Seven Seas and in the far corners of the globe. What a thrill this map must have given Britishers! I can answer for the impression of imperial might it gave the foreigner.

Then the map would go dark and successively there would appear new patterns showing the mineral, agricultural, fishing, and forestry resources of the Empire. Then again a pause and a new series, this time of the countries from which England secures her imports. Thus were shown many features of Empire economy, an ingenious use of education through the eye.

The other exhibits in this building were of equal interest and value. One could trace in attractive small models the development of the dress and equipment of the British soldier from early days to the present time. There were models, set in front of fine panoramic paintings, of strategic battles in the Great War. There was no end of exhibits of small and large ordnance and of models of naval vessels. The health work of the Empire was elaborately displayed. In fact, every department of His Majesty's government showed how it served his subjects. The Admiralty spread itself by having a theater with a large water tank built into the stage wherein were enacted famous British naval battles. I saw the blocking of the canal at Zeebrugge accurately reproduced, accompanied by no end of cannonading and the explosion of mines—realistic, impressive, conveying the conviction that the British navy is courageous and able, a strong arm of Britain's might.

So, if John Bull advertised his Empire to the whole world through the whole Wembley show, in his own building he advertised to his family how he served them. He did it well—and others beside his family profited by the display.

Australia and the C. P. R.—Of the colonies and dominions, Australia made, by far, the most impressive showing. She had fewer displays than Canada or India; her space, in her own building, which exceeded all other colonial or dominion buildings in size, was devoted to large scale representations of her chief industries. These representations were of the cyclorama type, large scale models surrounded by panoramic drops that accurately showed the topographic environment. Wheat raising, dairying, fruit raising, vine culture, mining, lumbering, cattle raising and sheep farming were all given their appropriate settings, while a display of the jungle showed the wilderness that can be found in places in that island of imperial extent. One felt, after completing a tour of the building, that he had gained some definite idea of what Australia is like.

The Canadian Pacific occupied its own building,

Photo by Campbell-Gray

COMBINED CONCRETE AND STEEL CONSTRUCTION
The concrete portions of the members were cast in advance. The steel members are hinged both at top and at their bearing on the concrete. This structure is the Palace of Industry.

small but well furnished to show its industrial and social impress on the territory it serves. The method was a combination of those used by the British government and by Australia—a large map of Canada with flashing lights, and a series of models against panoramic scenic drops. The map would show at the will of the operator the Canadian Pacific rail lines, and then, as visitors displayed interest, the location of the resources of the contiguous territory. One could be shown by a set of lights where copper was to be found, where zinc; where wheat was raised, where fur-bearing

Photo by Campbell-Gray

STEEL ROOF TRUSSES ON CONCRETE COLUMNS IN THE PALACE OF ENGINEERING

animals were trapped. There was a quick, inveigling inventory of Canadian resources as tapped by the C. P. R.

Over all was the suggestion, put forth in various association, that Canada welcomed immigrants, was prepared to help them get a start, and that the C. P. R. itself rendered aid. The exhibit should help swell emigration from Great Britain to the Dominion.

So much for some of the outstanding general features of the Exhibition.

Engineering Well Represented—Naturally engineering and its allied industry came in for due attention. The greatest strength of the engineering exhibit lay in its mechanical, electrical, railroad and marine features. Mining engineering had a distinguished feature in a model coal mine. Chemical engineering was shown almost entirely through its products and some flow sheets. Civil engineering, difficult to display in any event, came in for very little attention—save in the buildings themselves, which form a worth-while structural exhibit.

In the mechanical division the outstanding novelty of general interest was a large steam-turbine-driven locomotive.

The exhibit of steam turbines was especially varied, but, except for a model of a 50,000-kw. unit designed for a new Commonwealth Edison plant in Chicago, displayed no unusually new features. The model of the Chicago machine showed a three-stage unit with separate shafts for the high, intermediate and low pressures.

In the electrical engineering division, which, like the mechanical engineering division, was a very complete showing of British designs, the outstanding novelty was the "Transverter," a machine designed to convert alternating current at low pressure into direct current at high voltage. The machine exhibited at Wembley is the first to be built of commercial size, so that while high hopes are entertained for its future, it is not yet out of the experimental stage. The machine has a capacity of 2,000 kw. and converts three-phase 50-cycle alternating current at 3,300 volts to direct current at 100,000 volts. The machine has no moving parts except for the brushes, which are rotated by a small synchronous motor. A similar machine at the receiving end of the transmission line takes the high-voltage direct current and transverts it to low-voltage alternating current.

If the machine proves a success and can be built in large capacities, it may have an important influence on electric transmission in the future, for, by direct-current transmission, certain serious difficulties experienced in under-water and underground transmission by alternating current, are overcome. In addition, a given type of overhead transmission would have larger energy transmitting capacity with direct current than with alternating.

Model Coal Mine—Of wide general interest was the model coal mine, constructed by the joint efforts of the Mining Association of Great Britain, the Miners' Federation, and the Institute of Mining Engineers. Its popularity is shown by the 422,000 paid admissions between the opening date, April 23, and July 19. There are ¼ mile of workings, in which are shown the mining of coal in 2-, 3- and 4-ft. seams by hand, by air-driven and by electrically-driven cutting machines. Belt and shaking conveyors for loading coal into mine cars, hauling devices of all the sorts in use in Great Britain are shown in their appropriate environments. Competent guides explain the operations. Above ground are a modern tipple, with hoisting, conveying, washing,

Photo by Campbell-Gray

THE STADIUM DURING A CHAMPIONSHIP FOOTBALL GAME

The capacity—in the stands—is 125,000. The seating capacity is 25,000. The other spectators must stand. During the event pictured many more thousands crowded the playing field.

sizing and loading equipment, a modern electric substation for mine service, and a very remarkable collection of models, many of them with moving equipment, of mines and top works.

It is believed by those in charge that, aside from the value to mining men, the exhibit has been of great value to the industry in the education of the general public.

Structural Features—Of the buildings, most are temporary but the Stadium, the Palaces of Engineering and Industry, and H. M. Government Pavilion are of permanent construction, and form a fine display of concrete work, all manner of construction being employed—blocks, mass concrete and small-section precast structural members, as seemed best under the particular conditions. The Stadium and the Palace of Engineering

surpass all the others in magnitude. The Stadium will accommodate 125,000 people, 25,000 seated and 100,000 standing. The Palace of Engineering has maximum plan dimensions of 1,000 by 750 ft. and covers a floor area of 650,000 sq.ft. Accompanying views show the general structural features of the Stadium and the Engineering building. Details of the design, it is hoped, will be given in later articles.

Attention should be directed now, however, to the pleasing exteriors secured in the Stadium with mass concrete and in the other permanent buildings with precast concrete blocks. An exceptionally successful expedient has been the use of ribbing, secured by fastening beveled strips ½ in. wide and ½ in. high to the interior of the forms. By using this ribbing on corners and at other points where it was desired to break plain wall surfaces contrasts of color have been secured that give the appearance of projecting pilasters, though, in fact, the same plane is maintained. The effect can be seen in the close-up view of the Stadium exterior. In no case was it permitted to wash down or point wall surfaces after the forms were removed. Nevertheless, with the care taken, the surfaces are entirely pleasing. Construction joints in the mass work on the Stadium are concealed by the horizontal grooves introduced to simulate courses.

Attention should be directed also to the combination of concrete and structural steel for the roof construction in the Palace of Industry, and to the concrete pointed arches used in another part of the same building. Details of these designs will be given subsequently.

Another interesting engineering structure is the "never-stop" railway, in which, as its name implies, the cars move continuously. The speed at stations is 2 miles per hour and between stations, 16 miles. The cars, each independent, are propelled by a continuous spiral having a pitch at stations of 1 ft. and between stations of 8 ft. These spirals are driven by electric motors placed at intervals. The line is about three-quarters of a mile long and travels over 2,200 ft. of concrete viaduct and through a cut 1,500 ft. long.

Rapid Construction—In the construction of the Exhibition structures there was also notable engineering work. The entire Stadium, for example, involved 20,000 cu.yd. of concrete, 800 tons of reinforcing steel, 1,500 tons of structural steel and 150,000 cu.yd. of digging, and was built in 306 working days. The 2,200-ft. viaduct for the never-stop railway was built in eight weeks.

The Exhibition's Engineer—For engineers, this brief description of Wembley could not be complete without reference to the engineer responsible for the structural design and the construction. This is all the more called for because the engineer is now only 34 years old, rose by his own efforts through sheer grit and force, and when the Exhibition was opened was knighted by the King for his achievements at Wembley. His story is one such as we Americans believe can come only from new countries, such as our own and Canada.

The engineer is Sir E. Owen Williams, K. B. E., B. Sc., A. M. Inst. C. E. He started his engineering work at the age of 16 as a pupil on tramway construction, meanwhile studying evenings at London University and being graduated at the age of 21, with first-class honors. So rapid had been his advancement in his daily employment, despite the long hours spent in evening study, that at 19 he had charge of a tramway construction project costing $500,000.

The age of 21 found him, then, with five years of experience—two years in responsible charge of work—and an engineering degree. At once he began to apply himself to concrete design for which he had developed a special liking. He passed successively through the posts of assistant engineer with the Indented Bar Co., senior assistant engineer with the Trussed Concrete Steel Co., and chief assistant engineer with the latter corporation. Then came an opportunity to tackle a large complicated job and he became resident and designing engineer on the new concrete structures for the Patent Fuel Factories (which make briquets) in South Wales.

Photo by Campbell-Gray

SIR E. OWEN WILLIAMS, K.B.E., ENGINEER OF THE WEMBLEY EXHIBITION

The war turned his attention to the construction, first, of munitions factories, then of concrete tugs and barges — the latter of 1,000-ton carrying capacity. The time from breaking land for the shipyard to the launching of the first barge was 7 months. The whole layout of the shipbuilding plant and the design and construction of the vessels were in his hands.

In 1919 he entered consulting practice, which has kept him busily employed ever since, despite the depressions which England has experienced. He was appointed engineer for the British Empire Exhibition in 1921 and designed the structural features of all the major buildings, except those of Canada and Australia, and supervised the construction, collaborating with the architects, Sir John W. Simpson and Maxwell Ayrton. His versatility and engineering ability are indicated by the ingenuity of the designs at Wembley and his energy by the rapid progress of the Exhibition work.

If, then, the British Empire has a good show at Wembley, engineers have, both in arranging the engineering exhibits and in building striking structures to house the whole Exhibition, borne a worthy part.

Suburban Electrification in London

Good progress is being made with the electrification of the London suburban railway systems. On the lines of the Southern Ry. (feeding south east, south and south west England to London), of the 223 miles of track to be electrified conductor rails have been installed on 139½ miles, while the main line rails have been bonded and equipped with new angle bars over 136 miles. Electric high-tension cable has been laid over 26 miles, and the erection of the substations is well in hand, and in certain localities is completed. A considerable number of trailer coaches are being converted for use on electrified lines.

Replacing Railway Truss Span With Two Girder Spans

New Masonry Built Clear of Old Span—Falsework Supported Old Deck While New Girder Spans Were Erected

IN THE renewal of the Bluff Creek bridge on the Chicago, Rock Island & Pacific Ry. near Caldwell, Kan., special methods were employed for handling the new girders and for building new masonry around the old truss. A ballasted deck was also provided on the new bridge. As built in 1887-88 the structure was a steel deck lattice truss span of 155 ft. 3 in., supported on stone piers, with the rail level about 46 ft. above the water. Owing to the increased engine loads, trains for some years have been required to reduce speed over the bridge, but as increasing traffic made this plan inconvenient, replacement with a new structure was decided upon. This structure consists of two deck girder spans 77½ ft. long designed for Cooper's E-65 loading and under the American Railway Engineering Association's specifications of 1920.

Substructure—Since two spans were to replace the old single span and were very much shallower than the latter it was necessary to build a new center pier and also to build up the end piers to the elevation of the new bridge seats. Bedrock near the surface provided a good foundation for the former. The end piers had been jacketed with concrete some years previously and their dimensions were such as to permit of building concrete additions with the same batter as that of the lower portion. As this masonry had to be built before the truss span was removed, it was proposed to build only the central portion of each pier above the old bridge seats, this portion being between the trusses but wide enough to carry the closer spaced girders. The ends of the piers, which carry no load, would then be constructed later, being bonded to the main portion by projecting rods.

This plan was carried out in the new center pier, as shown in Fig. 2. In building the end piers, however, a better plan was devised, the new portion of each pier being built complete except for two chases or recesses left around the end posts of the old trusses, as also shown in Fig. 2. Reinforcing rods were left projecting to bond with the concrete which was poured to fill the recesses after the removal of the old steel span. The masonry contractor first built the center pier and the additions to the end piers, keeping clear of the old span. After the erection of the new span he returned to fill the recesses in the end piers and to build the ends on the upper part of the center pier. In the main or bearing portions of the piers the concrete was left for thirty days before any load was transferred to it. On this work, done in January, 1923, and March, 1924, the contractor used one small mixer and a gang of fifteen men.

Superstructure—In the new 77½-ft. spans the girders are 7 ft. 10½ in. deep, with four angles for the top chords. They are spaced 8 ft. c. to c. and each span has eight panels of top and bottom lateral bracing, with heavy cross frames at each panel point. An interesting feature is the solid deck (Fig. 3), consisting of transverse creosoted pine timbers 8x10 in., laid on edge; these timbers are 14 ft. long, boxed out ¼ in. over the girders. Every fourth timber is secured by hook bolts. To protect the steel, the tops of the girders were given a field coat of asphalt paint and covered with sheets of No. 13 zinc, 24 in. wide and in 7-ft. lengths, the sides of these sheets being bent down over the cover plates of the girders.

As the bridge is on a curve of 2 deg. and the ballast is shaped to give a superelevation of 2½ in., the outside guard timbers are 8x16 in. and 6x8 in. for the outer and inner side of the curve respectively. At each end of the bridge a transverse timber with its top cut to the required slope retains the stone ballast, which has a depth of 8 in. under the ties at the low rail. An apron plate covers the gap between the two spans. The guard timbers are bolted to the floor and are secured also by inclined braces spiked to the floor and to the top of the timbers. Inner guards of 80-lb. rails are laid across the bridge.

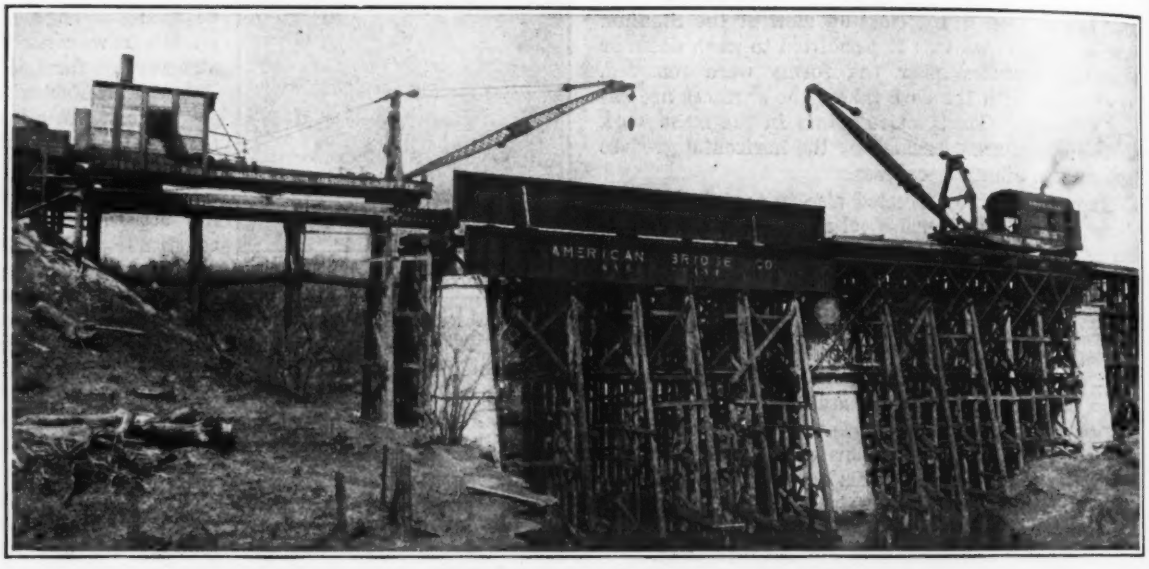


FIG. 1—PLACING GIRDERS FOR RENEWAL OF OLD TRUSS SPAN

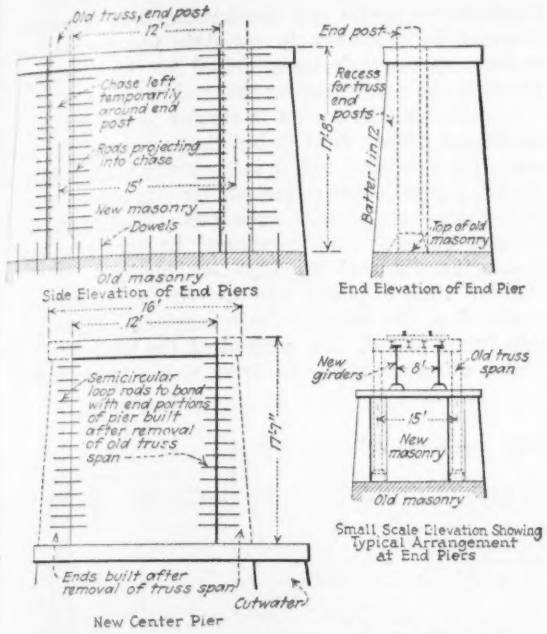


FIG. 2—NEW MASONRY CLEARS OLD TRUSS SPAN

Operations for Renewal—The first step was the construction of falsework to support the old deck truss span, as shown in Figs. 3 and 4. This consisted of 7-post trestle bents with caps about 6 ft. below the old floor stringers. These were pile bents, except for two framed bents on each old pier. Upon the caps were placed framed bents 6 ft. high carrying a deck of 8x16-in. stringers and cross timbers, which latter were blocked up under the four lines of steel track stringers of the old bridge. For the long span over the center pier the falsework stringers were 24-in. I-beams. During and after the removal of the truss, blocking on the falsework stringers was wedged up under the old floorbeams, so that the old floor system was supported by the falsework. With the trusses thus relieved from load, sufficient bracing was removed at the ends and the middle to permit building the new masonry between.

The new girders, delivered on cars, were carried out upon the structure by two derrick cars and then placed on the falsework caps outside of the truss. On account of the curve, both girders for each span were placed on the outer side, one on the top of the other, with the lower one braced temporarily to the truss. The old floorbeams and stringers were then torn out for one span, the short framed falsework bents were removed and the new girders were set in place inside the trusses.

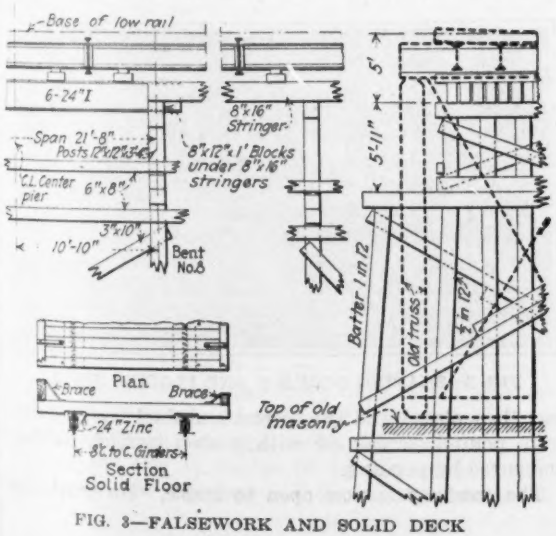


FIG. 3—FALSEWORK AND SOLID DECK

With the two girders in place, the top and bottom lateral bracing was bolted temporarily in position. The solid floor was then laid quickly and the track was replaced on blocking. From the beginning of the floor removal all operations were scheduled to be carried on at periods when train service would be least interrupted. Riveting was done under traffic. The second span was handled in the same way as the first.

Dismantling of the old trusses followed, the rivets being cut out so that the derrick cars could hoist the parts and land them on cars. After all this was done, the masonry contractor filled the recesses in the end piers and built the top of the center pier to its full length. The bracing of the new girders was then riveted up, the temporary blocking under the track was removed and the ballast and ties were placed.

Placing the new girders was the most difficult part of the work. Those of the first and second spans were placed April 8 and April 10. To reduce the delay to traffic, this work was started each day immediately after the passage of the southbound passenger train leaving Caldwell at 9:40 a.m., the next passenger train being due northbound at 1:15 p.m. The officers of the adjacent Oklahoma division were notified beforehand that the line would be blocked for this period and were requested to handle the business so that no freight trains would be run in or out of Caldwell between the two passenger trains. On the first day there was a little delay to traffic, but on the second day the change was made and track connected with a delay of only 40 minutes to the northbound train. On this day also, the railway bridge gang was moved to Caldwell to close the track and install the temporary deck.

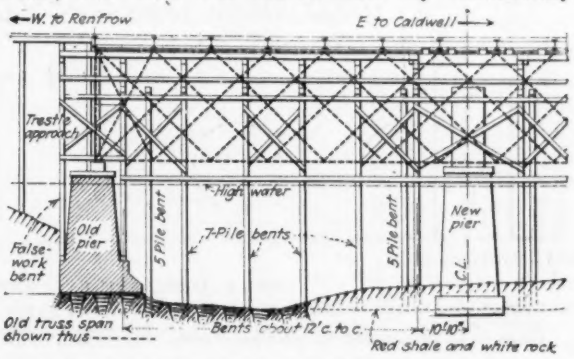


FIG. 4—OLD BRIDGE DECK SUPPORTED BY FALSEWORK

Steelwork for the new structure was fabricated by the American Bridge Co. and erected by the Kansas City Bridge Co., which latter also removed the old span. John W. Fox, El Reno, Okla., was the masonry contractor. The falsework, new deck and track construction were all handled by the railway forces. The design and construction were under the direction of Charles A. Morse, chief engineer, Chicago, Rock Island & Pacific Ry.; I. L. Simmons, bridge engineer, and S. T. Corey, assistant bridge engineer, with C. C. Cunningham, division engineer, Kansas Division, in resident charge.

Piles Through Old Swamp Roadbed Carry Concrete Road

Road Reinforced Like Flat Slab Floor in Building
Old Fill Brought to Grade Under Slab
Cost $9.50 a Square Yard

By C. N. Conner
Construction Engineer, State Highway Commission, Raleigh, N. C.

RECENTLY a very unusual and satisfactory type of heavy roadway construction through swamp land has been designed and constructed in the coastal plain of North Carolina. In the vicinity of Hertford, there is a swamp some 2,500 ft. in length over which a gravel and soil road has been maintained at a high expense for a great many years. It has been necessary from time to time during each year to add soil or gravel to the roadway surface on account of continued subsidence. Under the present state highway construction program a higher type of roadway was required at this location. Investigations showed that it would not be safe or economical to construct a hard-surfaced road on such unsatisfactory foundations. The swamp consists of 30 ft. of soft peat and muck, overlying hardpan and shell rock. Borings showed that material placed on this road for many years past had settled eight or ten feet below the swamp surface. Test loads also showed that the supporting power of this fill did not warrant risking probable subsidence and subsequent loss of a hard-surfaced road.

A possible plan was to place a sufficient amount of earth fill to break the crust of the swamp and allow this fill to subside and become stabilized after a period of many months. Another method would have been to construct a timber or concrete trestle. Either of these methods would have been expensive and would have tied up traffic for a considerable length of time, which was objectionable as this stretch of road is the only outlet to the northeast from the town of Hertford. Furthermore, while any construction was in progress, it would be necessary to maintain two ferries. The problem was satisfactorily solved by the construction shown in the accompanying cuts and photograph.

In principle, the design is similar to the flat slab or mushroom system used in building construction. It is somewhat empirical but it is generally recognized that all slab formulas are empirical. It was also recognized that the concrete could take some tension and that stresses could, where necessary, be increased above those generally used in bridge construction.

After timber piling was driven to the necessary penetration, the subgrade was regularly prepared and side forms placed. On account of the weak subgrade, it was often necessary to drive stakes to support the side forms. The first layer of concrete was placed and struck off by the unusual shaped templet shown in Figs. 2 and 3. This was so shaped that the steel fabric used could be placed in the required location. Fabric was then placed and the second and final layer of concrete poured, struck off with a steel templet, finished and cured by ponding.

The roadway is now open to traffic. No particular

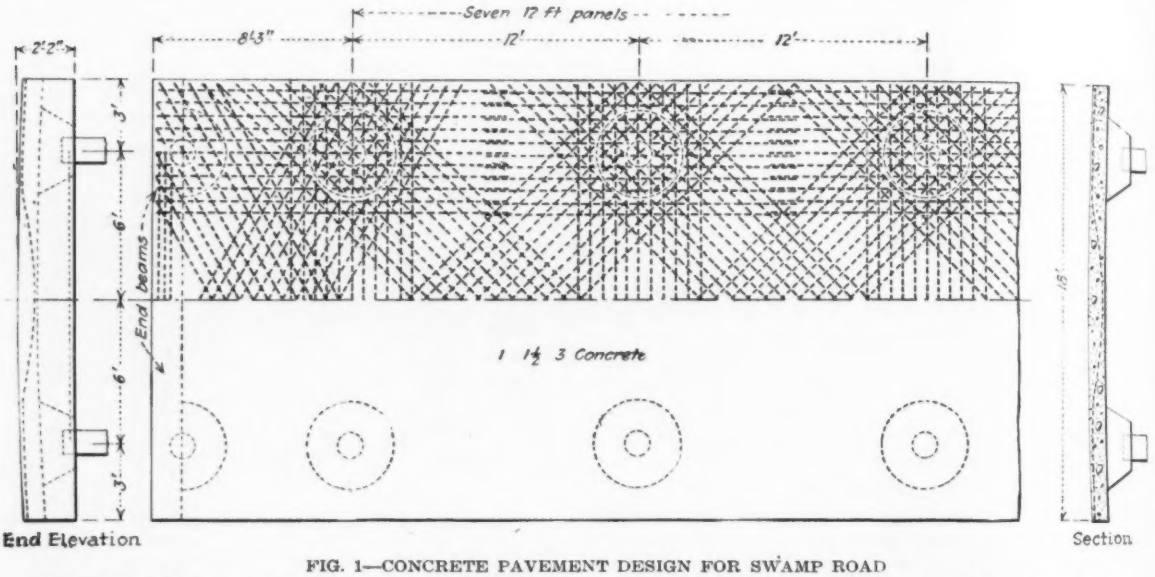


FIG. 1—CONCRETE PAVEMENT DESIGN FOR SWAMP ROAD

Timber piles driven to 15 tons bearing. Live-load two 10-ton trucks passing. Steel in tension 16,000 lb. per square inch. Concrete in tension 100 lb. per square inch. Concrete in compression 650 lb. per square inch. This design is based on the net areas of the main reinforcing steel in the fabric steel of 221 sq.in. and secondary reinforcement of 0.040 sq.in. per foot.

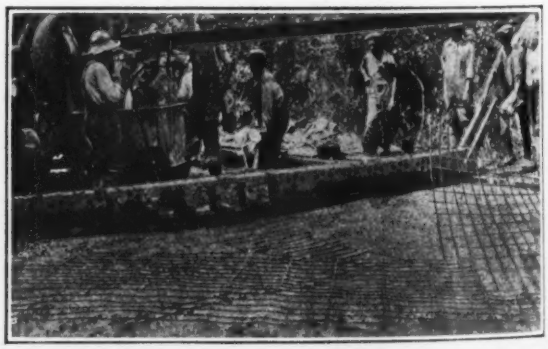


FIG. 2—SHAPING SURFACE AND PLACING STEEL

difficulties were experienced in any portion of the construction and the entire cost of this permanent pavement, including piling, preparing subgrade, but

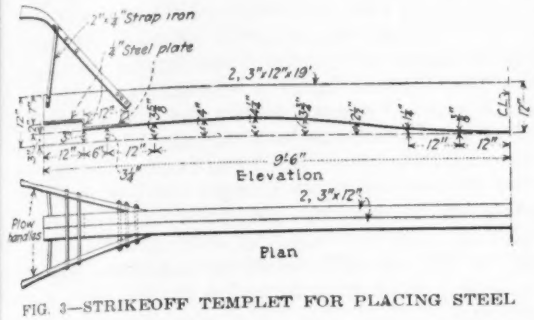


FIG. 3—STRIKEOFF TEMPLET FOR PLACING STEEL

excluding overhead, was approximately $9.50 per square yard, considerably less than any other permanent or semi-permanent construction would have cost in this location.

Atlanta Sells Steam from Incinerator to Railway and Power Co.

STEAM in excess of requirements for working purposes that for years past has been discharged to the atmosphere by the garbage and refuse incineration plant of Atlanta, Ga., is to be sold by the city to the Georgia Railway & Power Co. under a contract to go into effect Dec. 1 and to continue for ten years, with an indefinite extension in the future unless terminated by one side or the other.

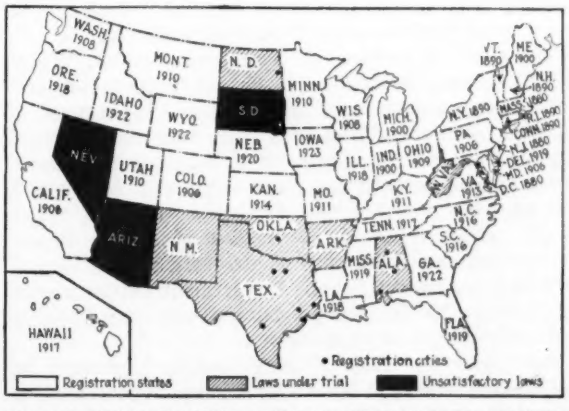
It is expected that during the winter months the steam thus bought will be used in the commercial steam heating system of the company named and that during the summer months the steam will be used at the commercial gas plant of the company. The contract requires very little outlay on the part of the city to deliver the steam to the operating plants of the company, and not very much outlay on the part of the company to make connections, including the provision of a meter to measure the steam delivered. The contract provides for the amortization within ten years of the expense just mentioned, on either side; also for recompensing the city or company as the case may be for the outlay for the purpose indicated in case either of the two parties to the contract forfeits the contract within the ten years. It is thought that the city can deliver steam at the rate of 22,000 lb. per hour, a total of some 200,000,000 lb. a year, but the engineers representing the city thought it was not wise to undertake to deliver so much. The contract therefore provides that the city shall supply 80,000,000 lb. of steam a year, at an average of not less than 260,000 lb. in each 24 hr., and at an hourly average of not less than 11,000 lb., the steam to be delivered at a minimum gage pressure of 170 lb., the pressure gage to be located at the city's plant. A variation of 10 per cent in the hourly rate of delivery is permitted. The steam is to be delivered dry and of any reasonable degree of superheat. When the steam delivered contains more than 1½ per cent of moisture the company may discontinue its use until such time as dry steam is provided.

In case the city is unable to supply steam at the contract rate, the company has the right to make up the shortage from its own equipment and to charge the city not to exceed 20c. per 1,000 lb. for whatever steam the company supplies for that purpose. The price to be paid the city for steam by the company is 16c. per 1,000 lb. for the first 70,000,000 lb. a year and 20c. for anything in excess of that amount, the payments to be made monthly. The contract provides for arbitration of otherwise unsettleable differences between the two contracting parties.

The foregoing information has been made available through the courtesy of W. H. Taylor, vice-president and general manager of the Georgia Railway & Power Co.

Ten States of the Union Still Outside Death Registration Area

PROGRESS in the enlargement of the death registration area of the United States and just what remains to be done to make it cover the whole country are shown by the accompanying map and explanatory notes. Proper action by three states only during the coming legislative sessions would give every state in the Union the necessary statutory authority to enter the registration area but these three and seven others would still have to provide or improve administrative machinery to ensure proper reporting and recording of deaths so as to bring the registration to or above the 90 per cent required for admission to the registration area.



DEATH REGISTRATION AREA OF THE UNITED STATES

From a map and explanatory notes prepared by the Bureau of the Census, Division of Vital Statistics

The *registration area*, which now includes 87.7 per cent of the total population of the United States, embraces 38 states and the District of Columbia, all having satisfactory laws and registering at least 90 per cent of all deaths; also 14 cities in non-registration states.
In addition there are 7 states with *laws under trial;* that is, with good registration laws, such as the Model Law, which have not been in force sufficiently long to bring registration up to 90 per cent.
Arizona, Nevada and South Dakota, have *unsatisfactory laws*, which do not and cannot secure good registration of deaths; for example, laws based on the "county system."
The figures indicate years in which states were added to the death registration area.

S. I. Zack Was Correct Name

In the article, "Tests of Air Pressure Losses in Activated Sludge Plants," *Engineering News-Record*, Nov. 20, p. 823, the name of one of the authors, S. I. Zack, was incorrectly given as S. I. Jack.

State Highway Officials Hold Tenth Annual Convention

Marking of Transcontinental Routes, Federal Aid in Public Land States and Pending Bills Discussed at San Francisco

Engineering News-Record Staff Report

THE American Association of State Highway Officials held its tenth annual convention in San Francisco, Nov. 17-20, with a registration totaling 276 and including delegates from 38 states and the territory of Hawaii. Subjects that received special attention at this meeting were the proposed Carlton bill that will facilitate federal aid in states of sparse population, the urgent need for more uniform road legislation throughout the different states, the need of some uniform system of road marking, and a series of standing committee reports which gave the results of the year's study of various road-building problems. Fifteen standing committees and subcommittees met and worked on annual reports, but for the most part these were simultaneous sessions on Monday afternoon and Tuesday morning, so that there was ample time for the ten formal papers and the business session.

The opening address by President Fred R. White, chief engineer, Iowa State Highway Commission, outlined the opportunities for service in the interest of better highways which await the association; urged that prompt attention be given to the matter of marking transcontinental routes, and vigorously condemned, and urged the association to oppose, the bill which would split up the U. S. Bureau of Public Roads, putting an important part of its work in the bureau of transportation under the Department of Commerce, and leaving to the present bureau only the building and maintenance of highways.

The paper on "How Shall Interstate Highways be Named and Marked" by A. H. Hinkle, superintendent of maintenance, Indiana, pointed out the necessity of locating and signing through routes expressly for the benefit of through traffic so as to "go near but not through congested districts." Answering the merchants' objection to this plan, he showed that traffic may become so heavy that it lessens instead of increases sales. A strong plea was made for giving every through route across the nation a number at the earliest possible date. For example, east and west routes might be given odd numbers, beginning with one along the Canadian line and using 99 for the route closest to the Gulf, while numbers 2 to 98 were applied to the generally north and south routes from the Atlantic to the Pacific. The Bureau of Public Roads was suggested as the agency best able to work out a generally acceptable plan of road marking.

Traffic Laws and Safety Devices—"The Urgent Need for Uniform Traffic Laws and Public Safety Devices" was the subject of a paper by Thomas H. MacDonald, chief, Bureau of Public Roads, in which he analyzed the conflict between various forms of transportation and the laws, some of them three centuries old, attempting to regulate these conflicts. He pointed out that after all this time "the problem is still unsolved and is now labeled 'urgent.'" Touching on the conflict between rail and motor transportation he stated that laws requiring a full stop at all rail crossings are unjust and in some cases only breed contempt for all traffic law. In certain instances it would be fair, he said, to stop the trains. He urged uniformity of traffic laws so that the reflex action which all drivers depend upon in those emergencies when there is no time to think would not be involved with different rules every time the driver crosses a state line. Mindful of the difficulties of getting states to abandon adopted systems of road markings, he was nevertheless favorably disposed toward joint work between the Bureau and the association in working out some uniform plan of legislation and road marking. The essential requirement in this, he said, would be widespread co-operation and a willingness to revise existing laws where necessary.

Discussion of Mr. MacDonald's paper brought out unanimous condemnation of laws requiring a full stop at all rail crossings and a general willingness to abide by any standard rulings the Bureau might make in the interest of uniformity of state laws.

Bond Issues and Traffic Surveys—In a paper entitled "To What Extent May a State Economically Issue Bonds for Road Construction" Frank T. Sheets, chief highway engineer, Illinois, pointed out that highway bonds were justified whenever the roads they produced would save enough to meet principal and interest payments plus maintenance cost and provided the taxation entailed would not be burdensome. Any limitation on yearly bond sales is economically unsound, he believed. Roads should outlive the bonds voted for their construction which, generally speaking, should not be for a period longer than 30 years. Before a state undertakes an extensive road program, sufficient tests or research work should be done to assure adequacy of the type of construction contemplated under local conditions. The Bates test road, he said, resulted in Illinois highway standards that have at least twice the load-carrying capacity of previous standards.

Discussion on this paper brought out the belief that it is unfair to advise states not to issue road bonds until the public and the highway commission are acquainted and the commission has public confidence. The logic on this was, "How can a boy learn to swim if not permitted to go into the water?" Significant proof of the saving that good roads afford was offered in figures from North Carolina showing a reduction in gasoline consumption as roads were improved.

"Highway Transportation Surveys," a paper by J. Gordon McKay, chief, Division Highway Transportation and Economics, Bureau of Public Roads, rated highways as the most important public improvement now under way, a total of $1,000,000,000 having been spent on roads last year. Many factors enter into thorough traffic surveys such as the density of vehicular traffic, wheel loads, traffic widths, need for new routes, saving in proportion to traffic, kinds and quantity of production in area served, long-and short-haul freight, and all these data must be arranged in practical, useful form. Long-haul freight traffic is decreasing and of what remains one-third to one-half is commodities from producer direct to consumer.

Figures recently compiled show fuel costs of 1c. per

ton-mile on improved roads as against 1¼c. per ton-mile on dirt roads. Connecticut highways are figured as paying 19 per cent interest on the investment. Even the steam railroads are taking advantage of roads in that state, the Pennsylvania system having 31 motor transport divisions with more in prospect.

James Allen, State Highway Commission, Washington, under the title, "Problems of Mountain Road Location," touched briefly on a wide variety of consideration confronting the locator in mountainous country. In the discussion of this paper, Dr. L. I. Hewes, Bureau of Public Roads, stressed the importance of highway location surveys and classed them as more difficult than railroad location because of the flexibility of the highway. He pointed out that a 6 per cent grade may be preferable to 5 per cent on a less favorable location and that well established principles of location may have to be abandoned for such considerations as putting the line where it will escape snow danger.

Research—"Some of the Recent Conclusions in Highway Research" was the title of a paper by A. T. Goldbeck, chief, division of tests, U. S. Bureau of Public Roads, who gave special attention to the design of concrete pavements, distribution of reinforcing, and conclusions as to cement-water ratio in concrete and its relation to wearing qualities of the pavement.

In a paper on "The Value of the Practice of Weighing Concrete Aggregate for Pavement Construction," R. W. Crum, engineer, Materials and Tests, Iowa, showed the advantage of apportionment by weight instead of by volume. As typical of results where this plan had been in use he read a letter from a leading Iowa contractor who had just finished a large paving job, using this method, and who credited it with being more accurate, less expensive, quicker and from every standpoint greatly to be preferred to the volumetric system. Discussion on this paper emphasized the importance of moisture content determinations when the weight method is used, a common practice being to make at least six moisture tests daily so as to regulate the mix as desired. Another point was that in the volumetric method, compactness of sand had a decided effect on actual quantity. For example a high drop from hopper to measuring box will materially increase the weight of a given volume.

Convict Labor on Highways—R. M. Morton, chief engineer, California Highway Commission, read a paper on convict labor in highway construction, which summarized to date California's experience with convicts on roadwork. The following has been abstracted from this paper.

Half of the 3,900 prisoners in California prisons are applicants for work in road camps. Since 1915, when the first prison camps were started, 220 miles of graded highway have been built by convicts, at an average cost of $21,900 per mile. A total of 4,378 prisoners have been employed in this work, their time totaling 7,214 man-years. The saving in prison-operation cost at an average of 76c. per man per day has been $1,129,295.

Legislation—A paper entitled, "Needed State and National Highway Legislation" by Harvey M. Toy, chairman, California Highway Commission, showed that unless legislation such as the Carlton bill is enacted, adequate transcontinental routes cannot be expected across the nine western states whose population density is less than ten persons per square mile (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah and Wyoming). Nevada, with a population of 0.7 persons per square mile and 74 percent of its area public land, cannot possibly provide funds to build trunk highways across the state. California civic organizations are now raising $50,000 to assist Nevada in matching federal-aid funds, a like amount having recently been raised in California for Utah. This, Mr. Toy said, is not a sound way to finance transcontinental highway building.

The Carlton bill will not increase the federal-aid allotment of any state but simply permits a state containing public lands and having less than 10 inhabitants per square mile, to concentrate its entire allotment, if need be, on primary highways within the 7 percent system. Granting the 100 percent federal aid will not be effective, however, without a repeal of the present square mile limitation, this would simplify the whole matter of federal aid and make the law more acceptable to western states that find difficulty in making up their allotment.

Committee Reports—The report of the Committee on Traffic Control and Safety received considerable attention on the floor of the main convention and in accordance with the suggestion contained in this report, a recommendation was adopted to the effect that "the association request the Secretary of Agriculture, in cooperation with the several states, to undertake immediately the selection and designation of a comprehensive system of through interstate routes and to devise a comprehensive and uniform scheme for designating such routes in such a manner as to give them a conspicuous place among the highways of the country as roads of interstate and national significance." The committee also recommended the adoption of a uniform method of marking the interstate roads and suggested that a difference in shape or color might well be used for the different kinds of markers and signs. In luminous signs the following sugestion was made:

(1) Red, to indicate danger or stop; (2) yellow, to indicate caution, or slow; and (3) green, to indicate look, or attention.

In non-luminous signs, lemon-yellow background with black letttering was suggested. The classification of non-luminous signs with different shapes that might be used as follows:

(1) Railroad warning sign, round; (2) danger or stop sign, octagonal; (3) caution or slow sign, diamond-shaped; (4) look or attention sign, square; (5) road markers (no shape suggested); and (6) directional and informational sign, rectangular.

Resolutions adopted by the convention included approval of the proposed federal-aid law (H.R. 4971), the Carlton bill (H.R. 6133), the National Park Roads appropriation, (H.R. 3682) and a resolution stressing the value and imyportance of the services rendered by Thomas H. MacDonald, chief, Bureau of Public Roads, and urging that his salary be increased to "not less than $12,000 per annum."

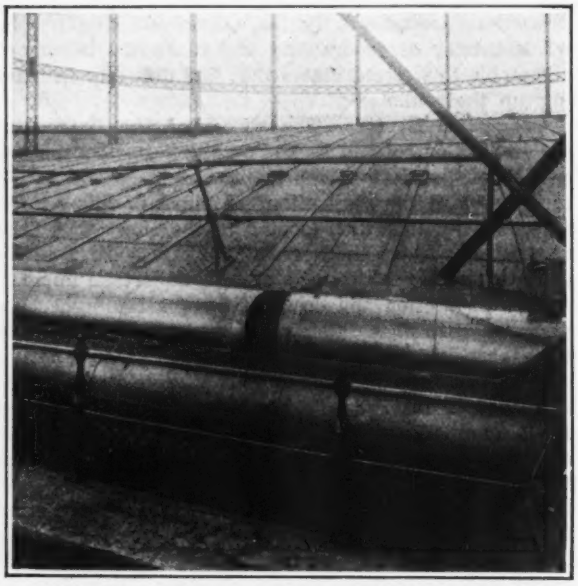
The election of officers for the ensuing year resulted as follows: President, Frank F. Rogers, state highway commissioner, Michigan; vice-president, Frank Page, North Carolina; treasurer, Frank T. Sheets, chief highway engineer, Illinois; secretary, L. D. Blauvelt, Colorado; executive committee, C. M. Babcock, Thomas H. MacDonald, and F. R. White.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Gas Holder Lifts Welded Together

A GAS holder at north Melbourne, Australia, shown herewith, is around 200 ft. in diameter, and has three lifts with a total capacity of 3,000,000 cu.ft. It has been in service for about 60 years. The holder now is weak and badly corroded in places. Some weeks ago while men were drilling bolt holes to place a bolted plate over a bad leak at about the center of the top lift the escaping gas caught fire, and, as the gas burnt, the



CURVED PLATES CONNECT GAS HOLDER LIFTS
Only the closure plate remains to be welded

entire plate tore out, and the lifts ran down until the water in the tank cut off the gas at the leak.

As a large and densely populated district is dependent on this holder for its supply, it was necessary that the repair be carried out as quickly as possible, pending the construction of another holder in the neighborhood. Obviously, the holder could not be pumped up again to repair the hole, so the engineers of the company decided to sacrifice part of the holding capacity by connecting the top and middle lifts.

This was done by placing strong straphangers at intervals round the crown curb plate, and welding them to the curb plate of the upper lift, and to the inside of the dip plate of the middle lift, thus rigidly connecting the two lifts so that they would act as one.

A ring of curved plates to cover the space between the two lifts was then fitted, the upper edge being welded to the curb plate of the roof. The lower edge was lap-welded to the dip plates of the middle lift. On completion the holder was put into service, and on being filled no leak was found.

The engineer responsible for the job was J. N. Reeson, chief engineer of the Metropolitan Gas Co. of Melbourne, Australia.

Design of Concrete Stair Slabs

By Jacob Feld
Brooklyn, New York

THE ACCOMPANYING tables give the design for all spans and usual conditions of self-supporting stairs of reinforced concrete. The average case of 10-in. treads and 7½-in. risers is used in all tables. The concrete slab is designed to carry the actual weight of the slab and steps at 144 lb. per cubic foot and 100 lb. per square foot, horizontal projection, as live-load. The slabs are considered as simple spans; landings are part of the span. In cases where a landing is common to two runs of stairs, a load equal to half the actual dead-load of the landing plus 50 lb. per square foot live-load over the length of the landing is carried by each span. The effective depth of the stair slab is measured normal to the slope of the stair run, allowing 1 in. covering for the reinforcement; the depth of the landing is measured vertically. The effective depth of stairs and landing is the same in all cases. The unit maximum fiber stresses are 16,000 lb. per square inch for the steel and 650 lb. per square inch compression for the concrete. The usual formulas resulting from the assumptions of no tension in the concrete and a straight line stress variation across normal sections of the slabs are employed. The following cases are covered:

Table A—Straight stair run, from 4 to 23 treads. The end risers are assumed 5 in. from the inner surface of the supporting beams. This distance is usually 4 or 6 in., depending upon the designer, and 5 in. is taken as an average value. The spans are measured horizontally and vary from 4 ft. 2 in. to 20 ft. Each step weighs 37½ lb. per linear foot, which is considered as an extra dead-load uniformly distributed over the span, 3.75 lb. per inch or 45 lb. per square foot. The dead-load of the main slab is 1.25 *b* lb. per square foot, horizontal projection, *b* being the normal thickness of the slab in inches.

A is the area of tension steel required per foot width of stairs, in square inches.

C is the volume of concrete in cubic feet per foot width of stairs.

S is the weight of steel required per foot width of stairs, in pounds. This includes the weight of the tension steel and also a ⅜-in. round rod under every second step to act as distributing steel.

Table B 1—The case of a single run of steps, varying from 1 to 17 treads, with a 66-in. landing at one end. The notation is the same as in Table A; the live-load is 100 lb. per square foot over the entire span.

Table B 2—The same case as B 1, except that the landing is 44 in. long.

Table C 1—The case of a single run of stairs, varying from 1 to 10 treads, with a 66-in. landing at each end.

Table C 2—The same case as C 1, except that the landings are 44 in. long.

Table D—The case is similar to that in Table C, but assumes that each landing is common to two-stair runs,

From Job and Office

For Contractor and Engineer

The warehouse framing was almost entirely fabricated by welding. No rivets were used, and only enough bolts to secure portability. That is to say, the purlins are fastened to the upper chords of the trusses by bolting to clip angles welded to the chords; the trusses are secured to the columns by bolts passing through bearing and column cap plates welded to the trusses and columns respectively: the side framing, carrying sash, door frames, etc., is bolted to clip angles welded to the columns; and the columns are secured to their concrete foundations by means of foundation bolts passing through steel footings welded to the columns.

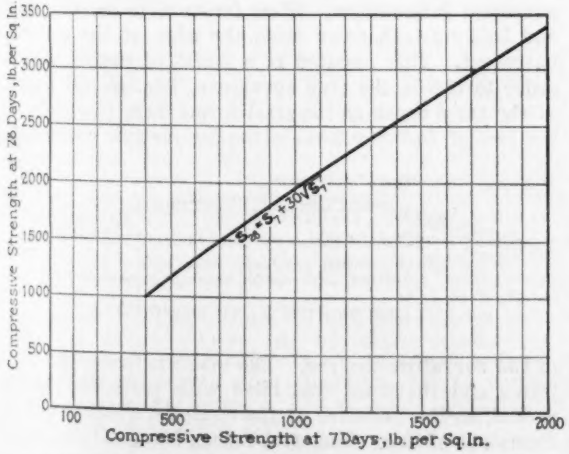
Since oxwelding has solved the joint problem, standard pipe can be used to replace economically many of the ordinary structural shapes used in direct tension or compression. This idea is being carried forward. In fact, one large industrial organization operating plants requiring buildings of a standard size and layout has designs under way for an all-welded pipe roof truss for use in all future buildings.

Relation of 7-Day to 28-Day Concrete Strength

TESTS recently made by the Bureau of Standards on concrete furnished at construction jobs suggested that there was a somewhat consistent relation between strengths at 7 days and those at 28 days. Further study has shown that the strength at 28 days based upon tests of laboratory specimens stored in damp sand has been equal to approximately the 7-day strength plus 30 times the square root of the 7-day strength. This relation has held true for concretes made from a large number of portland cements and for a large range of mixes. Since the strength at 7 days is likely to be nearly independent of the method of curing, this relation gives promise of affording a useful criterion for estimating at an early age the 28-day strength of concrete used in construction work.

This application to the field testing of concrete, a bulletin of the bureau says, should not be confused with the problem of determining in advance from suitable tests the adaptability, for any given work, of the concrete materials proposed for use in that work. The use of the criterion here described would not remove the necessity for these latter tests of the materials.

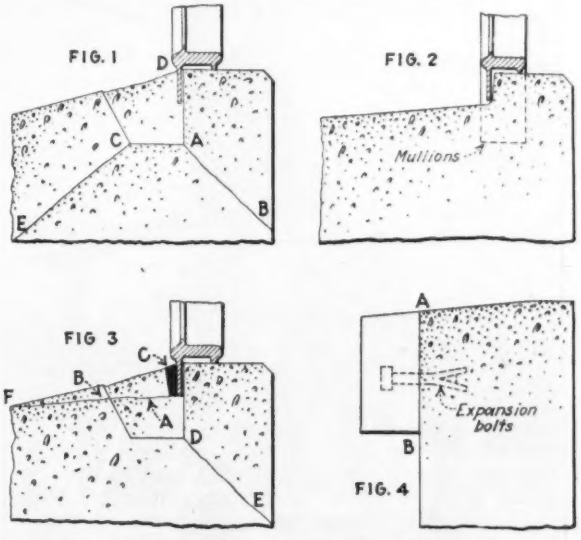
The accompanying curve represents the equation suggested above.



SUGGESTED RELATION BETWEEN 7-DAY AND 28-DAY CONCRETE STRENGTHS

Proper Protection of Reinforcing and Exposed Steelwork

IMPROPER embedment of reinforcing steel in concrete structures has frequently led to more or less serious results through exposure of reinforcing steel, its rusting and consequent spalling of concrete. In the development of reinforced-concrete construction, particularly for industrial buildings, a number of improvements have been recently added and at least two outstanding construction principles set down, says T. Arthur Smith, vice-president of the Turner Construction Co., in a recent issue of the house organ of that company. The following paragraphs are abstracted from Mr. Smith's article.



FIGS. 1-4—PROTECTING STEELWORK FROM CORROSION
Figs. 1 and 2—Improper and proper design for securing bottom of steel sash in sill. Fig. 3—Correction of defective detail shown in Fig. 1. Fig. 4—Dangerous tie of ornamental band to top of parapet wall.

Experience has shown that in order to construct an exterior wall that will successfully withstand the action of the weather it is necessary that the following points be carefully observed:

1. All steel reinforcement must be kept back from the exterior face of all walls and columns at least 2 in.

2. The building in of steel sash, door frames and other miscellaneous steel items must have careful consideration as to detail of recesses, method of anchoring, etc., so that steel members that are left exposed may be placed in such a manner as to permit them to be inspected easily and painted when necessary.

Several years ago it was common practice to specify that any steel left exposed for a bond in a future extension, was to be given a brush coat of 1:1 cement grout to prevent exposed bars from rusting. Only in the last few years has it developed that a brush coat of grout will not prevent the corrosion of steel bars.

Vertical column bars often have become exposed because of being placed too close to the exterior column form. If moisture penetrates the concrete covering sufficiently to cause formation of rust on the bar, the force exerted by the rust spalls off the concrete protection. When a portion of the concrete has been spalled off exposing a short

length of the bar the action of rust on the bar is very rapid. Corrosion will continue down the bar that is exposed, and has been observed to force off a concrete protection of 2½ in. and 3 in. For these reasons, all steel near the faces of walls and columns must be secured in its proper position so that a minimum of 2 in. of concrete protects the steel reinforcement from the action of the weather.

Our method of protecting steel from being too close to the exterior faces of columns is to place on the vertical column bars, at the time that the column reinforcement is assembled, circular concrete blocks, called "doughnuts." These blocks are made with a hole of sufficient size in the center so that the block can be slipped on the vertical column bar before the hoops have been tied in place. The use of these blocks prevents the column steel from becoming displaced and insures the positive protection of 2 in. of concrete covering over the steel.

The method of placing exterior steelwork such as steel sash, door frames, angle and channel guards, window grills, etc., requires careful study as to the type recess to be formed, and consideration must be given to the method of anchoring and building in of these members.

Figure 1 shows the method that was used several years ago to secure the bottom of the sash in the sill. This method has been found to be defective because if the sash is not constantly inspected and painted, moisture will attack the vertical leg of the angle at point *D*. Rust will form on this leg of the angle and in several instances it has been noted where rust thus formed has exerted sufficient force to shear off a section of the sill along the line *AB*, leaving the bottom of the sash without anchorage. In the majority of cases, however, the formation of rust on this member has forced off the portion of the concrete sill outside the face of this angle, shearing off the concrete along the line *CE*.

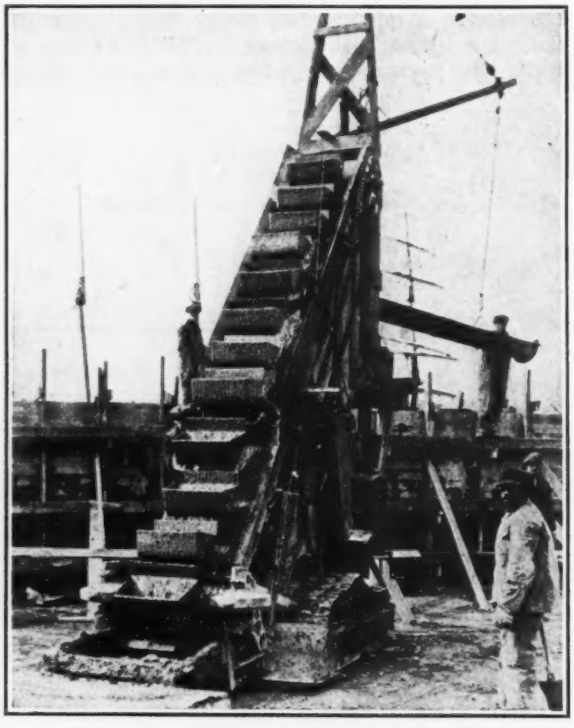
Correction of this defective detail is indicated in Fig. 2. We have found this sill detail superior in every way to Fig. 1, as sash set in this manner forms a weather-tight intersection with the sill. Should the bottom angle of the sash not be painted and corrosion start, then the action of the rust will not exert any pressure on the concrete sill, and consequently there is no danger of a portion of the sill being forced off. Further, the method indicated in Fig. 2 permits this steel sash to be easily inspected and painted at its most vulnerable point.

When the detail shown in Fig. 1 has been used, and the rusting of the angle entering the recesses has not progressed very far, a repair can be made as is shown in Fig. 3. The entire outside face of the embedded angle must be cut clear of the embedding mortar so that there is a space of from ½ to 1 in. between the face of the angle and the mortar. The angle must then be cleaned thoroughly of all rust and carefully painted with an approved paint. After this is done the space *C* must be filled with a mastic. Where the slope of the sill permits, this repair can be made by cutting the sill down to line *AF*, thus giving a detail identical with Fig. 2.

Corrosion of the steel members built into the recess at the jambs of the window openings can cause practically no trouble. The building in of steel guards for exterior columns, door openings, platforms, etc., requires that the method of placement be given careful thought so that no moisture can get behind the steel guard.

Another method which may lead to trouble is indicated in Fig. 4, showing the addition of an ornamental band to the top of a parapet wall. To place this ornament and anchor it to the building, holes were drilled in the top of the parapet and steel expansion bolts placed in them. Then a form for the band was built and the concrete placed. Several years after this work was done, the owners advised that a portion of the parapet wall had broken off and fallen. Fortunately this ornamental band was not over the sidewalk, but was over an adjacent building so no one was injured. An inspection showed that moisture had entered the joint *AB* between the parapet wall and the ornamental band and rust had formed on the expansion bolt. The force exerted by the formation of the rust was sufficient to force the band away from the parapet wall.

Bucket Loader Handles Concrete

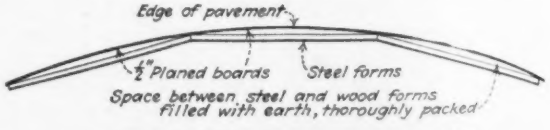


A NOVEL use for a bucket loader was recently proven successful by the Empire Construction Co. on a pier construction job. Pouring of 8-ft. columns necessitated the use of a portable unit. Adaptation of the bucket loader is told in a recent issue of *Successful Methods* as follows: the revolving disks of the loader were removed and replaced with a hopper into which the wet concrete was poured. A small chute, supported by an A-frame and boom attached to the loader, was used to pour the concrete when it had been elevated by the loader. As the loader was mounted on crawler treads, it could be moved from one column to another without appreciable delay.

Formwork for Short-Radius Curve

By Frank E. Harley
Assistant Civil Engineer,
New Jersey State Highway Department, Dover, N. J.

THE SKETCH herewith shows a method of securing a curve of short radius (88½ ft.) on a concrete pavement intersection. Steel forms were set to grade, and half an inch away from the edge of the concrete pavement. This resulted in a series of chords, and in order to obtain the true curvature, ½-in. planed boards of the same depth as the steel forms were placed inside the line of forms and were flexible enough to conform to the curvature desired. The space between the steel forms and the wood was filled with earth thoroughly packed, so the pressure of the concrete would not push forms out of line. The steel forms, being set to proper grade, supported the strike board when the concrete was stuck off and tamped.



DETAILS OF STEEL AND WOOD FORM

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Eccentrically Loaded Beam On Earth Support

Sir—In your issue of Oct. 30, p. 722, a problem of eccentric loading on earth is given by Paul Burke. According to the given conditions, the beam is assumed to be rigid. It rests on a smooth ground surface of homogeneous material. For any case of loading, the concentrated load is also such that the maximum unit pressure developed will be within the bearing value of the ground. With these assumptions the question is not difficult to solve. Similar problems of more complicated nature are encountered in reinforced work where column loads are unusually eccentric.

Due to the fact that the earth is incapable of exerting tensile reaction, the solution divides itself into two cases depending on the relative position of the load over the beam.

For the first case, when the concentrated load is situated within the middle third, the usual formula can be applied to find the unit pressure f at a point distant x from the center of the beam caused by the load P with eccentricity c.

$$f = \frac{P}{l} \pm \frac{12Pcx}{l^3}$$

The second case is when the load gets outside of the middle third. Then part of the compressive reaction is not large enough to neutralize the tensile reaction caused by the eccentric moment. But this tensile force cannot actually exist. So the problem has to be solved in a different way. From the fact that the two forces in equilibrium must be opposite in direction and equal in magnitude and also that the resultant of distributed forces represented by a right triangle is situated at a point one-third of the base distant from the origin, the result can be found readily.

Under actual conditions, with all factors to be taken care of, the problem is highly indeterminate and therefore exceedingly complicated. The foregoing theoretical solution treats of only the predominating effect after a few reasonable and simplifying assumptions are made.

It must be understood that the existence of slight elasticity in an actual case tends to make more uniform the distribution of the reaction. But a beam of shallow depth made of elastic material causes a severe concentration of reactive pressure directly under the point of application of the loading.

TIENPANG KUO.

Trenton, N. J.,
Nov. 1, 1924.

Sir—The problem presented by Paul Burke in your issue of Oct. 30, p. 722, is not capable of exact solution. An approximate solution can be arrived at provided certain conditions are known or closely estimated. It is, of course, necessary to know the section and elastic properties of the beam. It is also necessary to have or to collect enough information about the behavior of the supporting ground to establish the differential curve defining the settlement per unit load. As this will vary materially with the shape and size of the loaded area, and probably with the time-rate as well, exactness in this respect cannot be expected.

With such data the solution becomes a trial-and-error process. The problem is analogous to that of finding the deflection of a long pontoon under a concentrated load. In the case of the pontoon, the differential equation can be integrated mathematically; but for the case of a girder on a yielding foundation the integration can be performed only by graphical methods. The weight of the girder itself may be a considerable factor.

In the problem as presented, the beam is spoken of as rigid, meaning presumably that its deflection if simply supported would be negligible. Were the beam sufficiently flexible and the load near the middle, it is possible for the ends to lift clear of the ground, or even for the ends to touch or even bear while the beam closer to the load would be off the ground. Even when the rigidity of the beam is high, if the load is near one end the other may lift clear. Either condition makes the problem very complicated; but if the pressure is positive over the whole length, the solution is not difficult, though tedious, and due to the lack of real data only approximate anyway.

Vancouver, B. C.
Nov. 5, 1924.

H. B. MUCKLESTON,
Consulting Engineer.

Sir—The distribution of the reaction pressures for a beam resting on continuous elastic supports, for instance on a smooth, uniform ground surface, may be determined as follows:

The soil not being rigid will settle under the beam, as shown in the adjoining sketch. To simplify the solution of the problem it is usual to assume that this settlement is proportional to the reaction pressure p acting at this point,

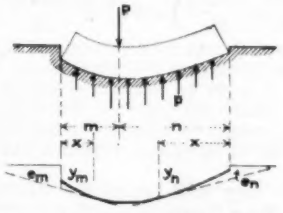


FIG. 1—CONDITIONS FOR EXACT SOLUTION

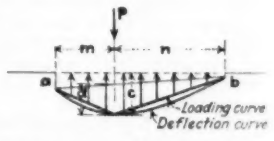


FIG. 2—APPROXIMATED CONDITIONS

or in other words, that $p = ky$, k being a constant for the soil in question. For any beam of moment of inertia I and modulus of elasticity E,

$$\frac{d^4y}{dx^4} = -\frac{p}{EI} = -\frac{k}{EI}\,y$$

If I is a constant, the solution of this equation is:

$$y = M_1m_1 + M_2m_2 + M_3m_3 + M_4m_4$$

where

$$m_1 = e^{ax}\cos ax \qquad m_3 = e^{ax}\cos ax$$
$$m_2 = e^{ax}\sin ax \qquad m_4 = e^{ax}\sin ax$$

$$a = \sqrt[4]{\frac{k}{4EI}}$$

M_1, M_2, M_3, M_4 are constants to be determined according to the loading conditions.

As the bending line of the beam consists of two branches, one extending from the left end to $x = m$ and the other from the right end to $x = n$, the solution of the problem is represented by two equations:

$$ym = M_1m_1 + M_2m_2 + M_3m_3 + M_4m_4$$
$$yn = N_1n_1 + N_2n_2 + N_3n_3 + N_4n_4$$

The two branches must fit together, or

$$ym - yn = 0, \text{ and } \frac{dym}{dx} + \frac{dyn}{dx} = 0$$

The fact that at this point the moment M for each branch is the same and that the sum of the shears V amounts to P furnishes the relations

$$\frac{d^2ym}{dx^2} - \frac{d^2yn}{dx^2} = 0$$

$$\frac{d^3ym}{dx^3} + \frac{d^3yn}{dx^3} = -\frac{P}{EI}$$

At the ends of the beam $x = 0$, and $m_1 = m_2 = n_3 = n_4 = l\cos O = 1$, while $m_3 = m_4 = n_1 = n_2 = l\sin O = 0$, As at this point neither shear nor moment exists, four other equations are given:

$$-M_1 + M_2 + M_3 + M_4 = 0$$
$$-N_1 + N_2 + N_3 + N_4 = 0$$
$$+M_3 \qquad -M_4 = 0$$
$$+N_3 \qquad -N_4 = 0$$

By these eight equations the constants M and N are determined, after which for any point x the corresponding y can be calculated and from it the reaction pressure ky.

This method being exact in itself still depends upon the accuracy of its assumptions. So, as the solution of the eight equations is tedious an approximate solution might be advisable for many purposes.

In the second diagram the distribution of the reaction pressures is assumed to be rectilinear from the ends of the beam to a point under the load. The fact that the moment at this point must have the same value for the two branches m and n, and that the sum of the reaction pressures equals P, is represented by the relations:

$$ka\frac{m^2}{3} + kc\frac{m^2}{6} = kb\frac{n^2}{3} + kc\frac{n^2}{6}$$

$$ka\frac{m}{2} + kc\frac{m+n}{2} + kb\frac{n}{2} = P$$

Calculating the deflections and equating the deflections at the ends and under the load to a, b and c, gives the relation:

$$c - a\frac{n}{m+n} - b\frac{m}{m+n} = \frac{k}{EI}\frac{mn}{m+n}\left\{m^3\left(\frac{a}{8}+\frac{c-a}{30}\right)+n^3\left(\frac{b}{8}+\frac{c-b}{30}\right)\right\}$$

These three equations are sufficient to determine a, b, c and the approximate reaction pressures ak, bk and ck. If b turns out to be negative, it is to be considered whether other uniformly distributed loads, for instance the weight of the beam itself, are heavy enough to balance the negative reactions. If not, the calculation should be repeated for a somewhat smaller n.

Finally, for comparatively very stiff beams the further assumption $I = \infty$ leads to those formulas which are commonly used for the computation of soil pressures under foundations.

New York City, Nov. 9, 1924. C. W. PANTKE.

Tests of I-Beams in Torsion

Sir—The Toronto tests of I-beams in torsion (C. R. Young and C. A. Hughes, University of Toronto, Bulletin No. 4, 1924) reviewed in *Engineering News-Record* of Sept. 18, p. 461, represent so much valuable experimental work that it seems desirable to discuss the results from another standpoint.

In the discussion given in the original bulletin the distinction between torsional strength and torsional stiffness is nowhere clearly pointed out. In addition, torsional strength is expressed in terms of "effective polar moment of inertia," which seems merely adding confusion to a subject which is in itself none too simple.

Although the problem of torsional stiffness and torsional strength is touched upon in textbooks of mechanics (see, for instance, Merriman, "Mechanics of Materials," 11th ed., pp. 227-250), the treatment in American texts is usually very summary and lacking in the clearness and completeness of presentation usual in beam theory. The following summary of the theory of the problem may, therefore, be worth while.

In the ordinary beam theory we find two characteristic dimensional properties of a section necessary for design purposes—moment of inertia and section modulus. The moment of inertia determines the deflection of the beam under stresses within the proportional limit. Beyond the proportional limit, the moment of inertia furnishes only a rough measure of the deflection, but in ordinary design we are interested only in deflections within this limit. The section modulus is, of course, not so satisfactory a measure of the strength of the beam, because in beam failure we are no longer within the limits of pure elastic theory. Nevertheless, except for failure in shear the section modulus gives us the best available measure for a rough comparison of the relative strength of different sections of the same material.

These two dimensional properties are necessary, since the strength of a beam is not determined by its stiffness; the more flexible beam may be the stronger. Similarly, in the problem of torsion two dimensional properties are necessary, since it by no means follows that of two shafts of the same material the stiffer one is the stronger. The two analogous dimensional properties are the "torsional stiffness" (J) corresponding to the moment of inertia (I) of beam theory, and the torsional "section factor" s, corresponding to the section modulus I/c of beam theory.

The first of these properties is the "torsional stiffness" of the section, $J = \frac{M}{\theta G}$, where M is the applied torque, θ the twist per unit length, and G the shear modulus of elasticity of the material. For stresses within the proportional limit J determines with all needful accuracy the twist of the shaft. Unfortunately, because of the warping of the sections, first pointed out by Saint Venant (M. des Savants étrangers, t. 14, 1855), J cannot be computed by simple methods for any except shafts of circular cross-section. Only in this special case is J equal to the polar moment of inertia.

However, accurate solutions exist (Love, "Mathematical Theory of Elasticity," 2d ed., pp. 298-313) for a number of simple geometrical shapes, as ellipse, equilateral triangle, rectangle. The soap film method of Prandtl (*Physikalische Zeitschrift*, Bd. 4, 1903), which was developed and applied by Griffith and Taylor as described in *Proc. Inst. Mech. Eng.*, Dec. 1917, pp. 755-789, gives satisfactory values for all solid sections. Workable approximations have been developed for various sections, including the I-beam (see also Föppl, "Drang und Zwang," 1920, pp. 56-160).

For none of these sections except the solid and tubular circular sections does the polar moment of inertia give even a rough approximation to the "torsional stiffness" J. How little relation exists between J and the polar moment of inertia is strikingly shown by the case of a tube of circular cross-section. Cutting a longitudinal slit in one side leaves the polar moment of inertia practically unchanged, but reduces the torsional stiffness to a small fraction of its former value. It is therefore only confusing to call a constant of torsional stiffness the "effective polar moment of inertia."

The second of these properties, called by Merriman the torsional "section factor," is defined by the equation $s = \frac{M}{S}$, where S is the maximum shearing stress occurring in the section under the action of the twisting moment M, and s is the torsional analogue of the section modulus of beam theory. Like the section modulus in beam theory, it is not a fully satisfactory measure of the torsional strength of a section, since here again failure involves stresses beyond the proportional limit and elastic theory gives only a rough approximation to the true conditions. Nevertheless, s is the best available measure for a rough comparison of the torsional strength of two different sections of the same

TABLE—ANALYSIS OF TORSION TESTS OF I-BEAMS

Section Depth In.	Section Weight Lb./Ft.	J In.⁴	Maximum Stress Occurs In	s In.³	Observed Data at Prop. Limit Twist Rad./In.	Observed Data at Prop. Limit Toque Lb./In.	Calculated From Observed Data Shear Modulus Million Lb./In.²	Calculated From Observed Data Maximum Shear Stress at P. Limit Lb./In.²	J (corrected) In.⁴	s (corrected) In.³	Calculated From Observed Data (corrected) Shear Modulus Million Lb./In.²	Calculated From Observed Data (corrected) Maximum Shear Stress at P. Limit Lb./In.²
3	5.7	0.0298	flange	0.1164	0.00378	3,000	26.6*	25,800	0.0468	0.1827	16.9*	16,400*
3	7.5	.0670	web	.1915	.00481	5,200	16.1	27,200	.1052	.3007	10.2	17,300
4	7.7	.0504	flange	.1756	.00561	5,400	19.1	30,800	.0791	.2757	12.2	19,600
4	10.5	.1247	web	.3118	.00400	9,600	19.2	30,800	.1958	.4895	12.2	19,600
5	10.0	.0866	flange	.2608	.00575	9,000	18.1	34,500	.1360	.4095	11.5	22,000
5	14.75	.2485	web	.5071	.00364	18,800	20.8	37,100	.3901	.7961	13.2	23,600
6	12.5	.1258	flange	.3475	.00356	8,000	17.9	23,000	.1975	.5456	11.4	14,600*
6	14.75	.1828	flange	.4954	.00291	11,000	20.7	22,200	.2870	.7778	13.2	14,100*
						Average.....	18.84			Average.....	12.6	18,400
						Average, excluding starred values (believed by Young & Hughes to be in error)					12.0	20,400

* Excluded from average.

material. There is, however, in general, no simple formula connecting s and J such as the relation I/c of beam theory.

The accurate determination of s for irregular sections is a matter of some considerable mathematical difficulty, since the stress at any point depends in general upon the shape of the whole section and not simply on the distance from the torsion axis. Thus, as mentioned by Young & Hughes, the maximum shearing stress in an I-beam may be either at the center of the face of the web or at the center of the outside face of the flange, depending on the dimensions and shape. It may even occur at the fillet joining web and flange if the fillet radius is too small, since regardless of the distance from the axis and the shape of the rest of the section the shearing stress at the vertex of a re-entrant angle is theoretically infinite.

Sufficiently accurate tables of J and s for all the standard structural shapes could readily be prepared by means of Prandtl's soap film method. The tables would, of course, be more limited in application than the corresponding tables for the problem of bending, since no simple general method exists for computing J and s for a combined section from their value for its elements. The preparation of such a table was suggested by Gibson in the discussion of the work of Taylor and Griffith.

For the ordinary structural I-beams and H-beams a relatively simple approximation has been found to give fair results (Föppl, pp. 99-102). This assumes that the beam has a torsional stiffness J the same as it would have if it were sawed into three separate rectangles. The rough approximation $J = \frac{1}{3}bt^3$ is used for each. Then for the combined section $J = \frac{2}{3}b_1t_1^3 + \frac{1}{3}b_2t_2^3$ where b_1 and t_1 are the breadth and thickness of the flanges, and b_2 and t_2 of the web. This is certainly too low an estimate for J. The twist in all three rectangles is assumed to be the same so that the maximum shear stress occurs at the center of the side of the thickest rectangle. So that in this case s may be determined from J by the simple approximation $s = J/t$, where t is the larger of the two values t_1 and t_2.

Computing on this basis, we find from the experimental results of Young & Hughes the figures given in the table herewith.

Excluding the first value, which is obviously discrepant and which Young & Hughes state they believe to be in error, these values of the shear modulus G agree as closely as could be expected. Föppl's approximate formula gives then, a fair comparison of the stiffness of these sections. However, the average shear modulus obtained is $G = 18.84$ million, which is 157 per cent of the usually accepted value of 12,000,000 lb. per square inch.

Over this range of I-beams the empirically corrected formula $J = 1.57\ (\frac{2}{3}b_1t_1^3 + \frac{1}{3}b_2t_2^3)$ gives a satisfactory approximation to the torsional stiffness. Recomputing the table with this correction gives the figures in the last four columns of the table.

The check in computed maximum stress between pairs of beams of the same depth is certainly as good as could be expected, but between beams of different depth the deviation from the mean is 28 per cent, or, if we exclude the three values which the authors believe to be in error, 16 per cent. Since only nominal and not actual dimensions of the beams are given and since no information is given as to variation in the quality of the material in the different beams, it is impossible to judge how much of these discrepancies are due to real differences in the beams and how much to errors in the approximate formulas.

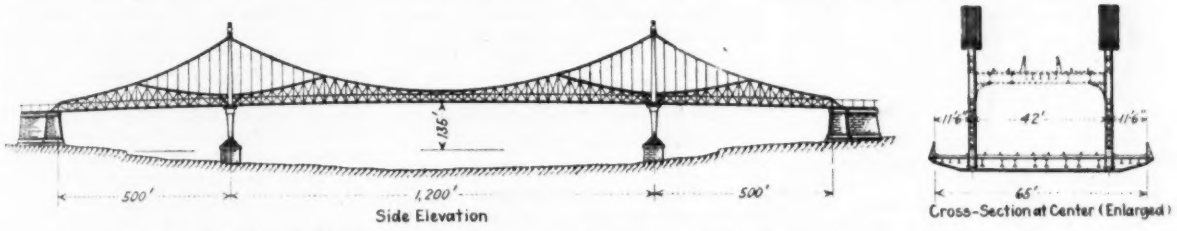
The discrepancies, however, are no greater than Young & Hughes found between their observed "effective polar moments of inertia" and those computed by their empirical formula $J' = \left(0.40 + 0.017\frac{d}{t}\right) A_m^{1.28}$, which varied from +33 to —29 per cent. In addition, Young & Hughes' formula is purely empirical, while Föppl's approximation has a sufficient theoretical basis to make interpolation or even extrapolation to other I- and H-sections reasonably safe.

The value of future tests of this kind will be much increased if, in addition to the torsion tests themselves careful determinations of actual section dimensions are made and the quality of the material is determined by sufficiently numerous coupon tests. Further, the test results should be compared with accurate values of J and s determined by Prandtl's soap film method or, if these are lacking, with some rationally founded approximation such as Föppl's or those suggested by Griffith & Taylor.

L. B. TUCKERMAN,
Engineer Physicist, Bureau of Standards.
Washington, D. C., Nov. 10.

Suspension-Bridge Stiffening Trusses

Sir—I have read with great interest in your issue of Nov. 13, 1924, D. B. Steinman's article on the "Design of the Florianopolis Suspension Bridge." Mr. Steinman dwells at some length on the theoretical and practical advantages of the "new form of stiffening trusses" used for the Florianopolis bridge. He states that "designs have been proposed in the past, in which the cable (or chain) would be utilized as the top chord of an overhead bracing system. It is believed that the Florianopolis design is the first one in which the desired advantages are secured while retaining a stiffening truss at roadway level from tower to tower."



DESIGN FOR BRIDGE OVER KILL VON KULL (1907), SHOWING VARIABLE-DEPTH STIFFENING TRUSS AT ROADWAY LEVEL USING CHAIN CABLE AS PART OF TOP CHORD

This is in error. At the request of some interested parties I made as early as in 1907 a design for a bridge across the Kill Von Kull between State Island, New York, and New Jersey, an outline of which in elevation and cross-section I am enclosing herewith.

The bridge was planned as a combination railroad and highway bridge. It was proposed to carry four railroad tracks, two surface-cars tracks, two narrow roadways and a footwalk. Because of the heavy live-load, amounting to 22,000 lb. per lin.ft. of bridge, and the greater stiffness required for railroad traffic, a deep stiffening truss became a necessity. From past experience with parallel-chord trusses and chain-stiffened trusses, the writer evolved the design shown on the sketch. This design was the more suitable because the comparatively short span of 1,200 ft. but slightly longer than that of the Florianopolis bridge, lent itself to the economic use of nickel-steel eyebars. The arrangement of the eyebars is shown on the cross-section. The lower chord is utilized as the chord of a horizontal wind truss, as usual. The trusses are discontinuous at the towers. For better appearance the truss ends at the towers show the line of the upper chord continued.

In 1911 R. Sonntag published an article in the German journal, *Der Eisenbau*, on "Economic Views and Proposals for the Construction of Stiffened Suspension Bridges" wherein he shows (p. 276) a sketch of a three-span bridge almost identical with the sketch shown here. Sonntag brings out the advantages of this type much as does Steinman.

LEON S. MOISSEIFF,
Consulting Engineer.
New York City,
Nov. 19, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Patent Centenary Observed by Cement Association

Part of Regular Meeting Devoted to Ceremony Commemorative of Aspdin Invention

The regular annual meeting of the Portland Cement Association of Chicago, Nov. 17-19, was marked by an afternoon and evening session in commemoration of the centennial of the patenting of portland cement by Joseph Aspdin in England. The afternoon meeting was given over to brief addresses by representatives of the different engineering societies interested in concrete and of the foreign cement interests.

President-elect Blaine S. Smith opened the meeting with a welcome and turned it over to Past-President F. W. Kelley, who delivered a centennial address. The speakers representing the technical societies were Prof. A. N. Talbot, American Society of Civil Engineers; Charles E. Fox, American Institute or Architects; H. R. Safford, American Railway Engineering Association; P. H. Bates, U. S. Bureau of Standards; Richard L. Humphrey, American Society for Testing Materials; A. E. Lindau, American Concrete Institute; Edward N. Hines, representing the Road Builders and Highway Officials. Gustave Deroover spoke for Belgium; Dr. Peter Hans Riepert for Germany; Charles Candlot for Paris; Poul Larson for Great Britain and Denmark, and A. Holter for Norway.

Future Problem

Professor Talbot emphasized the fact that the problem of the future in cement is how to make permanent structures. Mr. Fox, on behalf of the architects, called for a light-weight aggregate and a better finish for architectural strength. Mr. Safford, as a railway official, said that the railways wanted to use more concrete, but the future must show some way of making the product more nearly foolproof. Mr. Bates recited the history of government testing of cement and concrete and predicted better co-operation between producer and consumer in the future. Mr. Humphrey described the history of standardization, and Mr. Lindau took for his theme what cement means to the contractor. The foreign representatives' remarks were largely of a congratulatory and friendly nature.

In the evening the association gave a dinner to its members and guests.

The rest of the meeting had some very interesting papers and reports on the technical side of cement manufacture, particularly on waste heat boiler installations which were reported in some detail by Helmuth Krarup of the Hawkeye Portland Cement Co., and on high early strength cements by Dr. Gustav Haegermann, director of the German Portland Cement Association Laboratory. Dr. Haegermann's paper will be given in more detail in a later issue. It reeited some of the efforts being made by the German cement manufacturers to produce a true portland cement with a 1, 2 and 3-day strength equal to or comparable with the 28-day strength of the standard portland. The competition in Germany of the high early strength alumina cement has been so great that portland cement manufacturers have been led into this investigation. The high early strength portlands which they have produced are of practically the same composition as the ordinary portlands and follow all of the ordinary portland standards except those of early strength. The difference lies mainly in the manufacture in the more careful preliminary treatment of the constituent material. P. H. Bates, U. S. Bureau of Standards, confirmed several of the tests reported by Dr. Haegermann and emphasized the possibilities of this new development.

F. W. Kelley retired as president of the association after two years' service and has been succeeded by Blaine S. Smith, who is vice-president of the Universal Portland Cement Co. L. R. Burch, of the Atlas Portland Cement Co., is first vice-president and C. A. Irvin of the Chicago office of the Alpha Portland Cement Co., is second vice-president. Wm. M. Kinney is secretary and general manager of the Portland Cement Association, 111 W. Washington St., Chicago.

Engineers Are Named to Supervise St. Lawrence Bridge at Montreal

Dr. W. L. McDougall, chairman of the Montreal Harbor Commission, announces that work on the location of the site of the new South Shore bridge across the St. Lawrence at Montreal will be carried forward without delay. A joint association of designing and consulting engineers has been formed, composed of Monserrat and Pratley and Joseph C. Strauss; and also an advisory board of five engineers including T. W. Harvie, general manager of Montreal Harbor; G. Herrick Duggan; H. M. MacKay, dean of engineering faculty, McGill University; E. I. Vallee, chief engineer of roads and works, province of Quebec; and H. A. Terrault, city engineer of Montreal.

All designs and plans as to the site, and the structure of the bridge are to be submitted to these organizations who will report upon all projects and upon the selection of a site, carry out the necessary surveys and borings, supervise the making of plans and specifications and carry the work to completion.

St. Lawrence Engineering Board to Meet in Early December

The Joint Engineering Board, composed of the technical representatives of Canada and the United States, who are studying the St. Lawrence project, expects to meet early in December in accordance with the suggestion made by Canada. It is assumed that diversion will be the principal topic of discussion.

Members of Congress from Chicago are preparing to push legislation, at this session of Congress, which will authorize the diversion of 10,000 sec.-ft. from Lake Michigan. It is practically certain that no such bill can be passed, but it is believed the effort may result in a compromise under which the Corps of Engineers will be directly authorized to make a comprehensive study of the situation. In its previous studies of this diversion the engineer officers have labored under the difficulties incident to insufficient funds. Specific authorization for a report would remove that difficulty and would make available for the following session of Congress more complete data on which to base legislative action.

Philadelphia Bridge Cornerstones to Be Laid Dec. 12

Arrangements have been made by the Delaware River Bridge Joint Commission for setting the cornerstones of the two anchorages of the bridge on Dec. 12. The anchorages of the bridge are of concrete construction, faced with granite masonry, and they are outstanding architectural features of the bridge. Each anchorage has two large towers in which are located elevators, stairways and general utility rooms. The cornerstones are set in one of these towers for each anchorage.

The date on which the stones are to be set marks the anniversary of the date of organization of the Delaware River Bridge Joint Commission, Dec. 12, 1919. Ceremonies are being arranged for the occasion.

Manager Plan Defeated at Fresno, Calif.

A charter amendment adding a city manager to the commission form of government already in operation at Fresno, Cal., was decisively defeated at the election on Nov. 4, although supported by both local newspapers, the labor unions and all the city commissioners except William Stranahan, commissioner of public works. The population of Fresno was 45,082 in 1920 but W. F. Rantsma, deputy commissioner of public works, states that it is now 70,000.

Fabricators of Steel Adopt Commercial Practice Code

Governs Business Relations of Steel Buyer and Seller—Structural Handbook in Process

At the annual meeting of the steel fabricators' trade organization, the American Institute of Steel Construction, held last week at French Lick, Ind., a code of commercial practice was adopted This code, intended to define the respective contract obligations of buyer and seller of fabricated steel, covers the preparation of shop drawings, inspection, weighing, delivery, payment and related matters. It was drawn up by a committee headed by W. M. Wood, with the active assistance of Lee H. Miller, chief engineer of the Institute, and has been under informal discussion by members for several months. In adopting the code, the meeting authorized the directors to review and amend the code where this might be found necessary in order to perfect it for practical use.

Increased Stresses

Reporting on the progress made in securing acceptance of the 1,800-lb. working stress for structural steel which was recommended to the Institute two years ago by a commission of engineers employed for the purpose, Mr. Miller stated to the meeting that 25 cities have adopted this stress and the specifications recommended in connection with it, as part of their building codes.

A handbook of structural steel, intended to take the place of the separate handbooks, heretofore issued by rolling mills, is under preparation. Good progress in this enterprise was reported.

Subjects relating to improvement of shop and business practice in the fabricating industry were discussed in a number of papers read at the meeting. Uniform cost accounting, dealt with in a paper of W. R. Bassett, accountant, of New York, was also the subject of a committee report setting forth the fundamental requirements of a uniform cost method for the industry, which was endorsed by the meeting and referred to the directors for further action Other internal matters in which the Institute has interested itself are traffic, selling methods, and promotion.

Papers were read on sales training, by R. C. Hay of the American Radiator Co.; training of engineers, by A. E. Crockett, of the Jones & Laughlin Steel Corp.; local iron leagues, by R. B. Thomas of the New York Iron League; building inspection as related to structural steel, by Frank Burton, city building commissioner of Detroit; and fireproofing, by A. W. Sinnamon, of Cleveland.

Men prominent in political, business and educational life addressed the Institute at its annual dinner. They included Gov. Alfred E. Smith, of New York; Senator George H. Moses, of New Hampshire; Elisha Lee, vice-president of the Pennsylvania R.R.; J. W. O'Leary, vice-president of the Chicago Trust Co.; Dean Milo S. Ketchum, of the University of Illinois; and F. C. Kelly, of Washington.

Bear Mountain Bridge Opened

The Bear Mountain Bridge, spanning the Hudson River a few miles above Peekskill, N. Y., was opened to traffic Nov. 27, a dedication ceremony having been held the previous day. The bridge, which contains the longest suspension span yet completed, was constructed in the record time of about 18 months at a cost of approximately $5,000,000.

Gas Regiment Veterans to Reunite

New York and New Jersey veterans of the first gas regiment of the A. E. F., originally the 30th Engineers, will meet for a dinner and reunion Dec. 6, at the National Democratic Club, New York City. Previous reunions of this outfit, which was the only unit for gas and flame offense in the A. E. F., have been held on Armistice Day every year at Edgewood Arsenal, the Chemical Warfare Service arsenal and poison gas factory at Edgewood, Maryland.

At this meeting will be organized a New York and New Jersey association of members of the first gas regiment. Similar societies have been started in twenty-two other states. Further information may be obtained from Francis Phipps, Room 2700, Municipal Building, New York City.

Dedicate Champaign-Urbana Sewage-Disposal Plant

Dedication exercises of a formal nature initiated the beginning of operation Nov. 21 of the sewage-disposal plant of the Urbana and Champaign (Ill.) Sanitary District. A tablet was unveiled at this time recognizing the contributions that Prof. A. N. Talbot and Dr. Edward Bartow have made in solving some of the engineering and chemical problems pertaining to sewage disposal. Addresses were delivered by Dr. J. D. Dodds, vice-president of the district; S. A. Greeley, of Pearse, Greeley & Hansen, consulting engineers; Prof. Talbot and Dr. Bartow; David Kinley, president University of Illinois; and P. W. Wright, president of the district. G. H. Radebaugh, manager of the district, turned on the sewage and representatives of various women's clubs, the county medical association, Izaak Walton Club, Rotary and Kiwanis Clubs and Association of Commerce started the sumps and air lifts for sludge removal.

Charles F. Abbott, executive director, reported that during the past year the membership of the organization nearly doubled (from 100 to 182 fabricating firms), and now represents 97 per cent of the capacity of fabricating plants excluding those connected with the steel mills. The vitality of the Institute was indicated also by the attendance at the meeting, nearly 150.

J. L. Kimbrough, retiring president, delivered a stimulating address to the meeting on the advantages of co-operative effort on the part of the industry, a theme that was developed in other phases by some of the speakers at the dinner.

N. Y. Central Cutoff at Castleton Opened

High-Level Bridge over Hudson River and Great Freight Yard To Avoid Congestion at Albany

Engineering News-Record Staff Report

The $25,000,000 cutoff of the New York Central R.R. near Albany, N. Y., officially known as the Hudson River Connecting R.R. was formally opened for traffic on Nov. 20. The completion of the cutoff marks the culmination of over 20 years of effort on the part of New York Central officials, including much litigation over the Hudson River crossing.

The primary purpose of the cutoff is to avoid the low-level crossing of the Hudson River at Albany and the grades against both east and westbound traffic at that city. Details of what will be accomplished in the way of grade reduction and saving in distance were given in *Engineering News-Record*, Jan. 17, 1924, p. 108.

The project now opened for traffic includes 28 miles of double-track main line connecting the Boston & Albany and the Hudson River Division on the east side of the river, with the West Shore R.R. and the main line west of Albany on the west side of the river; 120 miles of track in a new freight yard at Selkirk on the west bank of the Hudson, engine terminals, car-repair shops, icing plants, and other terminal facilities at the new yard, and a high level double-track bridge one mile long across the Hudson River.

Description of Bridge

The bridge consists of one 600-ft. and one 400-ft. riveted through truss spans over the river channel and steel viaduct approach trestles extending from the bluffs on each side of the valley out to the channel spans. Clear height of the channel spans above high water is 135 ft.

The approach trestles have reinforced-concrete trough decks and the trusses have timber decks. The bridge is to be called the Alfred H. Smith Memorial Bridge, in memory of the late president of the railroad, under whose direction the project was planned and carried well toward completion.

Work on the Hudson River Division connection from river level, below the bridge, up to the bridge level on the east side has not yet been completed, and for the present only freight to and from the east over the Boston & Albany will be handled in the yard.

The engineering work was carried out under the direction of George W. Kittredge, chief engineer, J. W. Pfau, engineer of construction, R. E. Dougherty, designing engineer, J. H. Van Buskirk, mechanical engineer, and H. T. Welty, engineer of structures for the New York Central R.R., with Olaf Hoff of New York as consulting engineer on the bridge design. The field work was in charge of W. F. Jordan, principal assistant engineer N. Y. C. R.R., and B. C. Martin and B. W. Farnham, resident engineers. Construction, except for the steelwork of the bridge, was done by the Walsh Construction Co., and the bridge was built by the McClintic-Marshall Co.

Dam 3 on Tennessee Needed, Army Officer Reports

Must Act Now if Southern Utilities Are to Absorb Muscle Shoals Power Into System

Washington Correspondence

Dam No. 3 on the Tennessee River will be needed by 1931, is the opinion of Maj. Max C. Tyler expressed in a special report to the Chief of Engineers, if the power from Dam No. 2 is distributed through the interconnected system of the southeastern power companies and into new territory southwest of Muscle Shoals. Since four years will be required to build dam No. 3, almost immediate action must be taken toward securing the necessary legislative authority and the appropriation. If it should be found feasible to operate the nitrate plant Dam No. 3 would be needed in 1929, Major Tyler says.

Others of Maj. Tyler's conclusions, based on this latest engineering report on Muscle Shoals, are as follows:

"If the power from Dam 2 and the steam station is distributed locally and into new territory and is not sold or otherwise made available to the power companies for distribution through their transmission net, it will take a long period to load up the two plants, and there would be no justification at this time for the construction of Dam 3. The load factor on the plants would be low and the cost of power correspondingly high. The cost of power would come down to about $0.004 per kw.-hr. only when a demand somewhat greater than that now supplied by the Alabama Power Co. had been obtained.

Nitrate Plant Problem

"If power is supplied only for the operation of Nitrate Plant No. 2 and for local distribution and distribution in new territory, the time when the capacity of Dam 2 and the steam plant will be reached, also is problematical. Nitrate Plant No. 2 requires about 100,000 hp. at full load. There is so much disagreement among experts on processes for manufacturing fertilizer that it will take a considerable period of preliminary work before either of the nitrate plants can be operated at capacity. If we assume that Nitrate Plant No. 2 will use 75,000 hp. in three years, or say 450,000,000 kw.-hr. per annum, there will remain available capacity of about 400,000,000 kw.-hr. per annum for local and new territory distribution. This is almost as much power as the Tennessee Electric Power Co. produced in 1923 and would have to be absorbed before Dam No. 3 would be needed.

"Dam No. 3 is worthy of construction by the United States at the present time, provided, before authority for construction is given by Congress and appropriation of funds is made, that Dam No. 2 and the steam plant are leased under the provisions of the Federal Water Power Act, so as to insure the distribution of power through the interconnected system and in new territory to the West and Southwest and under terms which will earn for the United States interest and depreciation at reasonable rates on the capital invested therein for power purposes, viz, $42,199,162; and further, that the lease also cover Dam No. 3, at completion, with provisions for reasonable interest and depreciation payments to the United States on the capital to be invested therein for power purposes, estimated at $28,200,000. Or, if the plants are operated by the United States and power is sold, that long-term contracts, covering approximately the combined capacity of Dam 2, the steam plant and Dam 3 be made with public service corporations for the purchase of power for distribution through the interconnected system and in new territory to the West and Southwest, at such prices for generator voltage power at the plants as will pay maintenance and operating expenses and a reasonable rate of interest and depreciation on the capital invested or to be invested in the three plants for power purposes.

"About $3,100,000 in capital investment can be saved to the government by building Dam 3 with the organization and plant now available at Dam 2.

"The quantity of power that can be produced by the government plants at Muscle Shoals so greatly exceeds the amounts that may be required for fixation of nitrogen that the nitrate plants should be considered only as prospective large customers of the power plants.

"Storage at the headwaters will increase the quantity so materially and decrease the cost of primary power produced by run of river plants, such as Dam 2 and Dam 3, that the survey of the Tennessee River and tributaries being made by the district engineer at Chattanooga should be completed at the earliest possible date."

Highway Traffic Association to Meet Dec. 3

The annual meeting of the National Highway Traffic Association will be held in the new club house of the Automobile Club of America, 12 East 53rd Street, New York City, Dec. 3, 1924. Two sessions will be held in the ballroom, the first beginning at 2:30 and the second at 8 p.m. A dinner open to the public will be served at 6 p.m. in the grill room. Requests for dinner reservations should be sent to Elmer Thompson, secretary, Automobile Club of America.

The following traffic problems will be presented for discussion by leading traffic and highway transport experts: "Solutions of the Parking Problem in Congested Districts of Municipalities," "Enforcement of Traffic Regulations by Utilization of a Police Traffic Bureau," "Methods of Increasing Traffic Capacity of Streets," "State Fees for Commercial Motor Vehicles Operating as Private and Common Carriers," "Advantages and Disadvantages of Compulsory Automobile Liability Insurance," report of national committee on weights, dimensions and speeds of tractors, trailers and semi-trailers, "Methods of Forecasting Future Traffic and the Saturation Point in the Utilization of Motor Vehicles," and "Regulation of Pedestrian Traffic."

Sane Utilization of Forest Products Given Impetus

Committee Organized at Washington Conference Nov. 19-20 to Foster Waste Elimination

Washington Correspondence

A broad program looking to drastic reduction in the waste of forest products and definite encouragement of reforestation was agreed upon at the National Conference on Utilization of Forest Products held in Washington, Nov. 19 and 20. Not only did the conference adopt the program, but it provided a permanent organization to see that the program is carried out.

In providing the means for carrying out the resolutions of the conference a going organization was chosen. In view of the marked success which has followed the work of the Central Committee on Lumber Standards, of which John W. Blodgett of Grand Rapids, Mich., is chairman, it was the sense of the conference that its scope should be enlarged so as to include in its objective the purpose of this conference which are related to the work it has been doing.

The Central Committee on Lumber Standards was established two years ago at the suggestion of Commerce Secretary Hoover.

Recommendations Made

In addition to the recommendations as to permanent organization, detailed suggestions were made as to the activities which should constitute the program. The major subdivisions of these activities were along the lines of the application of available knowledge and those in the field of research. Under the first subdivision it is recommended that standardization be continued; that scientific principles be applied to piling, storing and drying lumber; that the use of wood preservatives be encouraged; that decay of pulp in storage be prevented; that diverse surveys be made looking to the utilization of waste products; that building codes be unified; that consumers confer as to improved practices; that the most improved practices be applied to public construction, and that all available information on these subjects be distributed systematically. An idea of the research program can be gained from these captions: Losses in the woods; sawmill waste; little used species; properties of wood; timber survey; wood-using industry survey; forest protection, and tropical woods.

The Central Committee on Utilization of Forest Products, charged with carrying the foregoing program into effect, is to be financed as follows: National trade and industrial associations, $500; regional associations, $250; regional associations if member of national association, $150; state associations, $100; commercial and civic organizations, $25. It is recognized that all of the agencies having an interest in the production, distribution, and use of forest products will not contribute, but because of the vital public interest in the entire problem it is believed that sufficient agencies will contribute to make possible the carrying out of the program.

Federal Power Commission Needs Funds for River Surveys

Emphasizing the need of complete surveys of the power possibilities of rivers of the United States, in order that a program may be prepared which will allow for the developing of each river to its maximum capacity, the Federal Power Commission, in its annual report, repeats the plea which it made last year for authority to use the funds received from licenses to enlarge its facilities so that it can carry on such surveys. The act which created the Federal Power Commission contemplated such an arrangement, but was not broad enough to make the use of the license fees available, and consequently the Power Commission has been working with funds provided by appropriations, the amounts of which have been gradually reduced, despite the increased needs of the commission, until now it is less than $40,000 per annum. This amount, the commission states, is not sufficient for it to attend to new licensing, and at the same time to give the amount of supervision to existing licenses contemplated in the law.

The income from licensing fees at the present time is sufficient, if made available, to carry on the ordinary work of the commission and to carry on the proposed river surveys.

Twenty-nine Ohio Counties Vote $15,210,000 for Roads

Twenty-nine counties of Ohio voted for good road levies at the recent November election, according to figures compiled by the Ohio Good Roads Federation, making $15,210,000 available for local road work. Counties in which levies were defeated are Adams, Auglaizem, Madison, Morrow, Brown, Fulton, Hardin, Huron and Logan. Ten counties which defeated local road levies last year voted for them this year. They are Champaign, Clermont, Delaware, Hancock, Jackson, Meigs, Morgan, Noble, Warren and Wood.

The levies range from 0.8 to 2 mills and the time periods extend from two to five years, with the exception of Paulding County, where it is 10 years.

The counties which adopted the road levies, the amount of levy, time to run and the total amount to be raised are:

Allen, 2 mills, 5 years, $1,350,000; Butler, 1 mill, 5 years, $775,000; Champaign, 1 mill, 3 years, $153,000; Clermont, 2 mills, 5 years, $280,000; Clinton, 2 mills, 5 years, $410,000; Delaware, 1 mill, 5 years, $245,000; Franklin, 0.8 mill, 5 years, $2,800,000; Greene, 2 mills, 5 years, $510,000; Guernsey, 2 mills, 5 years, $460,000; Hancock, 1 mill, 2 years, $192,000; Harrison 1.5 mills, 5 years, $277,500; Jackson, 2 mills, 5 years, $210,000; Lawrence, 2 mills, five years, $410,000; Lorain, 1 mill, 4 years, $704,000; Lake, 2 mills, 5 years, $900,000; Marion, 2 mills, five years, $780,000; Meigs, 2 mills, 5 years, $210,000; Morgan, 2 mills, 5 years, $180,000, Muskingum, 1 mill, 5 years, $400,000; Noble, 2 mills, 5 years, $170,000; Paulding, 2 mills, 10 years, $760,000; Perry, 2 mills, 5 years, $370,000; Richland, 1 mill, 5 years, $510,000; Seneca, 1.5 mills, 5 years, $607,500; Shelby, 2 mills, 5 years, $480,000; Warren, 2 mills, five years, $400,000; Wood, 1 mill, four years, $388,000; Vinton, 2 mills, 5 years, $140,000; Wyandot, 1 mill, 3 years, $138,000.

Transport Congress Dec. 8-9

The transport congress which was originally scheduled to take place in Boston, Dec. 11 and 12 (see *Engineering News-Record*, Nov. 20, p. 847) will be held Dec. 8 and 9 instead.

Tablet to Locomotive Designer Unveiled at York, Pa.

A tablet which bears the inscription "Phineas Davis, born 1795, died 1835, Mechanical Engineer, Designer and builder of the first successful coal burning locomotive. A tribute from the Engineering Society of York, Pennsylvania, assisted by the Baltimore and Ohio Railroad and citizens of York," was unveiled at York, Pa., on Nov. 27. The Baltimore & Ohio R.R. Co., which has preserved one of the four demonstration locomotives which Mr. Davis built in York, will send it to York to be on exhibition there during the unveiling.

Gov. Silzer Fills Two Vacancies on Port Authority

Governor Silzer of New Jersey has announced the appointment of Frank C. Ferguson, of East Orange, N. J., to fill the vacancy created by the resignation of Frank R. Ford from the Port of New York Authority, and Schuyler N. Rice of New Brunswick, N. J., to succeed DeWitt Van Buskirk whose term has expired. The appointments have to be confirmed by the New Jersey Senate.

Mr. Ferguson is collector of internal revenue for the fifth district of New Jersey, president of the Union Trust and Hudson County National Bank and of the Merchants National Bank of Jersey City, vice-president of the New Jersey Bankers Association and treasurer of the Jersey City Chamber of Commerce. Mr. Rice is executor and trustee of the estate of the late George J. Gould.

Drainage and Reclamation Meeting to Be Held in Chicago

In connection with the annual meeting of the National Drainage Congress at Chicago, Jan. 5 to 7, there is to be held a National Fertile Land Conference and also the annual meeting of the National Landowners Association. The land conference is to devise methods of getting fertile land in profitable production of farm crops and the abandonment or reforestation of lands unsuitable for agriculture. Legislation affecting the use of fertile lands, land settlement and taxation under new conditions imposed by changed immigration laws will be studied and plans developed to protect land from undesirable real estate promotion. There will be group meetings of drain-tile manufacturers and investment bankers. At the Drainage Congress special sessions are to be devoted to: (1) Tile drainage, (2) waterways and flood control; (3) drainage and irrigation methods; (4) land settlement; (5) land management; (6) legislation.

Water District for San Francisco Peninsula Proposed

The San Francisco board of supervisors on Nov. 10 passed a resolution authorizing a committee to represent the city in conferences with cities south of San Francisco in San Mateo and Santa Clara counties "for the purpose of ascertaining the needs of such municipalities in respect to an adequate water supply; and if deemed feasible and practicable by all concerned, to recommend the means by which these needs may be satisfied; and in this connection to give consideration to the formation of a metropolitan water district."

Co-operation with the cities of the peninsula south of San Francisco in the matter of water supply has been suggested from time to time. The success of a highway district in which San Francisco and the counties adjoining on the south work together to good advantage is cited as illustrating the benefits of such co-operation and the situation is believed to be further cleared by the fact that on Nov. 4 the voters of the east-bay cities authorized the issuance of $39,000,000 of water bonds for a supply from the Mokelumne River, previously recommended by a board of engineers as preferable to joining San Francisco in the Hetch Hetchy project.

In proposing the resolution, Supervisor R. J. Welch pointed out that a metropolitan water district could be formed including San Francisco, San Jose (some 45 miles down the peninsula) and all the territory between without obligating these municipalities in any further consolidation. Two weeks prior to the resolution a movement was started in San Jose to buy the privately owned water-works in that city and to join in the Hetch Hetchy project by building a conduit from Irvington southward.

Illinois Central Lets Contracts for Chicago Electrification

The placing of orders for 120 motor passenger cars and 120 trailers for use in the Chicago suburban zone has been announced by the president of the Illinois Central R.R. These cars are for use on the 37 route-miles of track extending 28 miles south of Chicago which the railroad company announced in 1922 that it would electrify. Direct current at 1,500 v. with overhead conductors will be used.

The lines to be electrified will be those now operated by steam between Randolph St. terminal, Chicago and Matteson, Ill., Kensington and Blue Island, and between 67th St. Chicago and South Chicago.

Each motor car will be equipped with four 250-hp. direct-current motors geared for a speed of 57 m.p.h. The trailers will be semi-permanently coupled to the motor cars so that the ordinary arrangement will be to make up trains composed of one or more pairs of cars all controlled by one motorman. Each car will have a seating capacity of 84.

Iowa Water-Works Men Hold 3-Day Session

Seventeen Papers Read at Iowa City—Superintendents Have Round-Table Discussion

Seventeen papers, three motion picture talks and a round-table discussion of ten topics comprised the three-day meeting of the Iowa Section of the American Water Works Association at Iowa City, Nov. 6 to 8. The round-table topics referred entirely to problems of the superintendent, such as fire hydrant spacing, waste surveys, service connections, accounting and boiler room stunts.

A determined effort was made to keep the laboratory material to a minimum because of undue criticisms of the large amount of laboratory papers on last years program. An inexpensive autoclave was described by E. E. Wolfe, chemist, Hannibal, Mo.; differentiation of B. Aerogenes by chinic acid, by B. H. Butcher Iowa State College, and a new test for nitrates by G. W. Burke, also of Iowa State College.

Water Treatment

Treatment of water was covered in three papers. The first was on "Treatment of Railroad Supplies," by C. R. Knowles, Illinois Central Ry. N. T. Veatch, Jr., consulting engineer, Kansas City, Mo., gave results of operating the softening plant at Topeka, Kan. H. V. Pedersen, state sanitary engineer, made a plea for the purification of surface waters by small towns rather than continuance of futile attempts to obtain an unpalatable ground water often found polluted. It is amazing, he said, how much the water in the wells of many parts of the state has been receding, driving the cities to the use of surface supplies.

Lafayette Higgins, consulting engineer, Des Moines, called attention to the exasperating indifference of the small town official to the condition of his water supply. He also pointed out the financial difficulties and the unsuccessful attempt two years ago to obtain legislation which would permit cities to finance mains by special assessment. Thomas Maloney, Council Bluffs, chairman of the committee having the matter in charge, was authorized to reintroduce the bill into the coming legislature.

The problem of the small town getting competent advice was discussed at length because so few competent men are interested. J. J. Hinman, Jr., State Board of Health, stated that the mayors and superintendents consistently failed to respond to notices of the board to send in samples. One town he said was still relying on an analysis made in 1900. Well pits without number in Iowa seem to be designed with drains leading to sewers inviting a back flow which gets into the water through a leaky casing. Mr. Hinman referred to a typhoid epidemic of 75 cases and 4 deaths directly traceable to such an installation.

Prof. C. O. Bates, city chemist, Cedar Rapids, in his paper on "Protection of the Cedar River Drainage Basin," made such an impassioned plea for cleaning up pollution by sewage treatment that the section passed a resolution requesting the secretary to get it as much publicity in local newspapers as possible. Two towns, Austin and Albert Lea in Minnesota, are about to construct sewage disposal plants and the State Board of Health has ordered Cedar Rapids and other towns to do likewise. The Izaak Walton League and other nature preserving associations are strenuously at work in the attempt to make all the cities of Iowa stop polluting the streams.

Progress of the proposed manual of the American Water Works Association was outlined by W. W. DeBerard, member of the Standardization Council with George W. Fuller, Frank A. Barbour, W. S. Cramer and Edward E. Wall, having the manual in charge. The manual will summarize in a few hundred pages the essential facts upon which the business of water supply rests and outline current practice. Seventy-five topics have been assigned. Committee chairmen are responsible for reviewing specific features of practice assigned to them but many subjects are outside the restricted fields of committees and individuals have been asked to epitomize these subjects. Still other subjects are being developed by questionnaires.

The following officers were elected for the coming year: Chairman, Max Levine, vice-chairman, H. V. Knouse, Directors, N. T. Veatch, Jr., and J. W. McEvoy. J. J. Hinman, Jr., Iowa State Board of Health, Iowa City is secretary.

Detroit to Establish a Municipal Airplane Field

Condemnation proceedings to acquire 150 acres of land as a start towards an airplane field are to be started by the city of Detroit. The location is near Jefferson Ave. and Water-Works Park, within 15 minutes by automobile of the downtown section of the city. The area to be bought will be enlarged by filling in the Detroit River to the harbor line. Until this has been done the site will be used as a municipal refuse dump. The Department of Public Works has been instructed to build spur tracks to facilitate the dumping and filling.

Giant Power Survey Board Asks Delay on All Power Permits

The Pennsylvania Giant Power Survey Board has asked Governor Pinchot, the Public Service Commission, and the State Water and Power Resources Board to withhold approval of all requests for enlarging the privileges or rights of public service power generating, power transmitting and power distributing companies by way of charters, mergers, certificates of public convenience and necessity, approval of projects or by other means. The board believes that the state should enter into no commitments on the subject of power development until the Giant Power Survey is submitted to the legislature next January. The governor has announced his intention of complying with this request.

Random Lines

More!

Recreation Engineer—An official position in the United States Forest Service.

Space Saving Engineers—A rapidly growing cult; already reported from Dayton, Ohio, and New York City. Seem to be furniture salesmen.

Paint Maintenance Engineer—To be distinguished from previously reported *paint engineer*, whose job it is to apply certain oil and pigment combinations to the surface of structure; sometimes inaccurately termed house painter. The new breed appear to be the gentlemen who sell the "paint engineers" the wherewithal to paint.

Help Wanted, Male. 33.

BEATER ENGINEER—Only thoroughly experienced in roofing felt need apply Stormcote Roofing Corp. East St. Louis.

* * *

A Vile Word, As Polonius Might Say

Under the appropriate heading "Blah" *The Film Daily* records the following comment on a new picture: "Designed by the world's greatest *filmgineer*, Jesse L. Lasky." In the world of the blind the one-eyed man is king.

* * *

A Reaction From He-Man Stuff

"The small number of distinguished American writers has been increased by one . . . a style that *breathes* superbly. Mr. Burke is a discoverer in the field of *aesthetic engineering*, a creator of cool and lovely designs."—*The New York Evening Post.*

Showing the Satevepost influence on the once meticulous dean of New York journalism.

* * *

Government Railway Management As Is

A Spanish correspondent of the *Railway Gazette*, London, doesn't like the way the Spanish government runs its railways. He says the new Railway Council, men unfamiliar with the railways and the various districts, had to fix within a few days an entire readjustment of rates for more than eighty railways. They rather bungled the job but "we have long been used to this sort of exaggerated centralization. When there is congestion, for example, in the Barcelona goods warehouses, a nicely-worded Royal Order issues in the *Madrid Gazette*, to be applied all round, even to the humblest little roadside station in Galicia. Despite the obvious differences in traffic conditions, State regulation of the railways is conducted from the Ministry in Madrid through the medium of shoals of Royal Orders, most of which fortunately do not get beyond the columns of the *Gazette*. It may be that the forthcoming rate-fixing and other well-intentioned efforts of the Railway Council will also be tempered in the same way."

Engineering Societies

Calendar

Annual Meetings

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, Dec. 2, 1924.

ADVISORY BOARD ON HIGHWAY RESEARCH, Washington, D. C.; Annual Meeting, Washington, Dec. 4-5, 1924.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Colorado Section of the American Society of Civil Engineers together with engineering students from the University of Colorado recently inspected the flood conservancy work at Pueblo, Colo., steel mills and other industrial works.

The San Francisco Section of the American Society of Civil Engineers held its regular bi-monthly session Oct. 21 as a joint meeting with the student chapters of the University of California and Stanford University. After a dinner and a short business meeting, the evening was given over to a "surprise" program of entertainment.

The Texas Section of the American Society of Civil Engineers held its regular fall meeting Nov. 13-15 at Dallas. An excursion was taken to the new Garza dam of the Dallas municipal water-works on Nov. 15.

Personal Notes

ALEXANDER FRASER, of Montreal, engineer of the road department for the Montreal District, has been appointed chief engineer of the road department of the Province of Quebec.

J. L. BURKHOLDER, for the last two and one-half years assistant administrator in charge of construction work for the Barahona Sugar Co., Barahona, Dominican Republic, has returned to the States, having completed a 20,000-acre irrigation and drainage project involving a $200,000 diversion dam and $750,000 of drainage work. Mr. Burkholder was for 12 years with the U. S. Reclamation Service, finally becoming chief drainage engineer.

C. H. SCHWARTZ, formerly assistant engineer with the Miami Conservancy District, at Hamilton, Ohio, is now located at Osborn, Ohio, where he is field engineer for the Southwestern Portland Cement Co.

E. C. FOUST, who has been with the Miami Conservancy District, Dayton, Ohio, for the past nine years, has accepted a position with the Bureau of Sewerage of the city of Akron, Ohio.

A. C. GODWARD, for many years engineer for the Minneapolis Board of Park Commissioners, has resigned and has accepted the newly created position of efficiency engineer for the Minneapolis Board of Estimate and Taxation. The latter board is the tax levying body of the city. Mr. Godward will continue to serve as engineer for the Minneapolis Planning Commission.

WILLIAM H. ADAMS and RALPH W. ADAMS consulting engineers, 504 Hofman Building, Detroit, announces the termination of their partnership, effective Nov. 15. Both will continue in business as individuals at the same address.

SIDNEY B. WILLIAMSON, until recently consulting civil engineer with Guggenheim Bros., New York City, and formerly division engineer of the Pacific Division of the Panama Canal and subsequently the first chief of construction of the U. S. Reclamation Service, announces the opening of engineering offices at 30 W. Third Ave., Birmingham, Ala., and in the National Bank Building, Charlottesville, Va., with his son, LEE H. WILLIAMSON as associate. The two will maintain offices for consultation, examinations and reports, design and supervision of concrete structures, power development, water supply, irrigation and drainage, industrial, docks and coal handling plants. Sidney B. Williamson, who graduated from Virginia Military Institute in 1884, spent several years in railroad engineering in the Northwest and some months in general engineering practice in Montgomery, Ala. From 1892 to 1900 he was employed on government improvements on the Tennessee River, which included construction of the Colbert Shoals lock and care and operation of the Muscle Shoals canal. Then followed service as assistant engineer in charge of the fortification work at Newport, R. I., and three years as engineer of the Expanded Metal Engineering Co., New York, designing and making estimates of reinforced-concrete buildings. In 1907 Mr. Williamson was appointed to the work at Panama and directed concrete and earth dam construction work, docks, and municipal construction. In 1912 he went to London as chief of construction for J. G. White, Ltd., and in 1914 became chief of construction for the Reclamation Service. Later he went with Guggenheim Bros., but his work there was interrupted by service as colonel of engineers, with the 55th Engineers, in the World War. The son, Lee H., was educated in engineering at the University of Virginia, saw service in the Panama Canal construction work, has done railway construction and engineering work in Chile and Europe, was a member of a firm of engineers and contractors in Charlottesville, Va., and was a lieutenant of engineers with the 55th Engineers.

Obituary

DR. ALFRED HULSE BROOKS, chief of the Alaskian Division of the U. S. Geological Survey, suffered a stroke of apoplexy at his desk Nov. 21 and died at the Emergency Hospital in Washington, November 22. He was 53 years old. Dr. Brooks had been in charge of the surveys of the Alaskan division for twenty years and was regarded as the greatest authority on the mineral resources of that territory. He covered more territory in Alaska on his numerous expeditions than has any other technical man. He was chairman of the first Alaskan Commission, which studied all the possible routes for the railroad. During the war, Dr. Brooks served as a lieutenant-colonel of engineers. Col. Brooks was born in Ann Arbor, Mich., July 18, 1871. His early education was acquired at a private school in Newburgh, N. Y. He was graduated from Harvard in 1894. He also studied at German and French universities. During the drafting of the Treaty of Versailles, Col. Brooks served as one of the experts advising on the economic resources of the central powers. He was awarded the Malte-Brun gold medal of the Geographical Society of France, the Daly gold medal of the American Geographical Society and an honorary degree of Doctor of Science was conferred upon him by Colgate University.

GEORGE T. LAPOINTE, construction engineer, died in Norwood, Man., Nov. 15, at the age of 68 years. Mr. Lapointe came from his native province of Quebec to western Canada in 1881, engaging in construction work. In 1889 he settled in Winnipeg where for many years he was employed in connection with important building enterprises. He was for ten years construction engineer of the Winnipeg Exhibition grounds.

JOSEPH U. CRAWFORD, at one time consulting engineer of the Pennsylvania R.R., died Nov. 21 at his home near Philadelphia, in his 82nd year. Mr. Crawford's life was spent in railway work from 1865 on. He made early surveys across the Allegheny Mountains and in New England, became senior engineer of the Alexandria & Fredericksburg R.R., a part of the Pennsylvania system, in 1871, and later was engineer of the California Division of the Texas & Pacific R.R. From that work he went to Japan on appointment as consulting engineer on the Japanese imperial railways, and he was twice decorated by the Japanese emperor for his services. Later he made surveys in the West for the Gould lines, and in 1882 he returned to the service of the Pennsylvania R.R., served on many of its divisions and rose to the position of chief engineer of branch lines. He was consulting engineer for the Pennsylvania R.R. from 1911 to 1912, when he retired at the age of 70.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Paving Brick Production Mounts in October

Paving brick production for October shows an increase over September of nearly half a million brick, according to the monthly statistical report submitted to the U. S. Department of Commerce by the National Paving Brick Manufacturers Association.

Shipments for October were 29,142,000 brick as against 31,563,000 for September. This was a smaller falling off than would naturally be expected at this time of the year when the seasonal nature of pavement construction is taken into consideration.

Unfilled orders for October were 59,496,000 brick as against 74,089,000 for the last day of September. Stock on hand Oct. 31 was 73,604,000, showing a reduction of stock in the last month of more than 13,000,000 brick. The foregoing figures cover reports of 20 companies representing 59 per cent of the tonnage capacity of the industry. These companies reported production at 91 per cent of their normal monthly tonnage capacity.

Japan's Reconstruction Delayed

Permanent reconstruction in Japan will not begin for three years, according to the Far Eastern Division of the Department of Commerce, if the public declarations of the government can be taken as a criterion. There must be plans for the physical reformation of streets and the adjustment of land holdings. Japanese bankers and experienced industrial leaders appreciate the fallacy of the statements of early adjustments, and they go so far as to predict that it will be a decade or longer before this gigantic reconstruction program becomes a reality. The temporary buildings will not give way to permanent construction until necessity requires and in any case they are protected by law for a period of five years. At the end of that period it will depend upon the prosperity of the individual as to whether he will or will not reconstruct his building.

In the meantime whether the city and national governments will carry out their announced program of reconstruction and expansion of pubic utilities prior to the expiration of the five-year period, remains an open question. The present temporary structures have been built on approximately the old locations and the carrying out of the ambitious street reconstruction program will involve the destruction or removal of a large number of them. It is obvious, therefore, that the protection of these buildings for a period of five years will automatically postpone the street improvement plan until the expiration of that period.

The present Cabinet is committed to a program of retrenchment and has

Introducing a New Feature:

Monthly Index Number For Locomotive Crane Sales

Through an arrangement made with the Locomotive Crane Manufacturers' Association *Engineering News-Record*, beginning with this issue, will report every month a figure that will serve as an index of conditions in the locomotive crane manufacturing field. This figure represents monthly sales of locomotive cranes expressed as a percentage of the normal capacity of the plants of the seven leading manufacturers constituting the association, of which C. F. Michael, Ohio Locomotive Crane Co., is chairman; R. W. Kaltenbach, McMyler-Interstate Co., vice-chairman, and E. C. Pierce, Brown Hoisting Machinery Co., secretary and treasurer.

The index figures for September and October follow, October sales being the lowest for any month of the current year.

INDEX OF LOCOMOTIVE CRANE SALES

Month, 1924	Per Cent of Normal Capacity
September	29.0
October	28.5

The foregoing figures are based on returns received from the following manufacturers:

Brown Hoisting Mchy. Co.	Link Belt Co.
Browning Co.	McMyler-Interstate Co.
Industrial Works	Ohio Loc. Crane Co.
	Orton & Steinbrenner

(*Concluded from First Column*)

already announced several contemplated reductions in governmental expenditures. It is almost certain, therefore, that the reconstruction budget for the next fiscal year will be substantially reduced, and that this reduction will continue through the next four or five years.

Business Notes

CHICAGO PNEUMATIC TOOL CO. has appointed H. E. Byer manager of condenser and vacuum pump sales with headquarters in the New York office.

HOLT MANUFACTURING CO., Peoria, Ill., has appointed Haverstick & Co., Inc., Ford & Spring Sts., Rochester, N. Y., as distributor for its caterpillar tractors in western New York.

WHITING CORPORATION, Harvey, Ill., manufacturer of cranes and foundry equipment, has opened a district sales office at 997 Ellicott Square Bldg., Buffalo, N. Y., to succeed its former agent George F. Grivel & Co. The new office will be in charge of W. R. Hans who has been with the Whiting Corporation for many years.

HEINE BOILER CO., St. Louis, Mo., has appointed R. C. Broach, until recently in the general sales department, as its southeastern district manager with offices at 709 Glenn Bldg., Atlanta, Ga. His territory will include eastern Tennessee, North and South Carolina, Alabama, Georgia and Florida.

THE WYCKOFF PIPE & CREOSOTING CO., whose office is at 522 Fifth Avenue, New York, and factory at Portsmouth, Va., has just completed an order for furnishing 1,000,000 ft. of creosoted wood conduit for underground transmission wires for a single customer, and over 200,000 ft. for another customer, besides numerous orders for smaller amounts of the same material.

E. E. SIEG and J. C. HAGGART, general sales manager and chief engineer, respectively, of the Republic Motor Truck Co., Inc., Alma, Mich., are making a trip to the Pacific Coast to investigate the truck situation in that territory. Starting with San Diego and Los Angeles, Mr. Sieg and Mr. Haggart will visit distributors on the coast up to Seattle, Wash. On the return trip, stops will be made at Denver and several Texas distributing points.

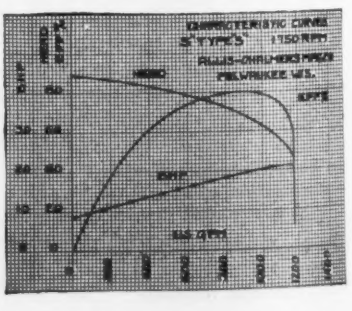
KALMAN STEEL CO., Chicago, manufacturer of steel reinforcement and other building materials has recently moved its St. Paul office from the Merchants National Bank Building to the new Builders Exchange Building, 6th and Jackson Sts.

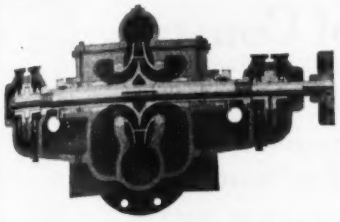
Equipment and Materials

Low-Head Centrifugal Pump

To its line of centrifugal pumps, the Allis-Chalmers Manufacturing Co., Milwaukee, has added a new low-head unit which is built in the smaller sizes and is similar to the company's type S pump, with the addition of a number of mechanical improvements. In the new pump bronze is used extensively for such parts as companion wearing rings, split inclosed glands, stuffing box throat bushings and shaft sleeves.

The unit is equipped with double-acting center collar thrust bearing on the outboard end and split bearing shells with two oil rings. Oil is led to





the center of the bearing and is kept away from the ends to afford circulation. Waterseal passages are integral in the upper half of the casing and can be arranged for outside seal when necessary. Shaft nuts are designed to act as oil throwers to keep oil in the bearings; shaft sleeves are designed to prevent water which might creep along the shaft from entering the bearings.

The performance of this pump is shown by the accompanying characteristic curves for a 5-in. unit. It will be seen that for 900 gal. per minute against 68 ft. head an efficiency of 80 per cent is obtained; the efficiency is above 70 per cent from 520 to 1,120 gal. per minute.

A Large Venturi Meter

A large Venturi meter, having a 48-in. inlet reducing to a throat diameter of 40⅝ in., has just been supplied by the British Pitometer Co., Ltd., affiliated with Glenfield & Kennedy, Ltd., of Kilmarnock, Scotland, for the Dolgarrog hydro-electric project in North Wales. The inlet piece, throat piece and outlet piece are of welded steel construction, all joints being faced and registered. The throat piece is fitted with a phosphor bronze welded liner, 2-in. copper pipe, pressure rings, pressure cocks, air cocks, and tee pieces.

The material forming the Venturi tube is open-hearth steel having good welding properties and a tensile strength of from 24 to 28 tons per square inch with an elongation of 20 per cent in a length of 8 in.

Angle Irons With Legs of Unequal Thickness Patented

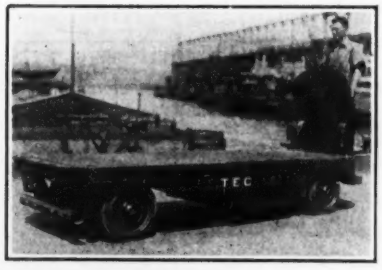
For structural work angle irons with legs of unequal thickness are now patented products. The claims of William J. O'Sullivan, of Norfolk, Va., were recognized by the U. S. Patent Office in Patent No. 1,498,526 granted June 17, 1924. The object of the invention is "to provide structural angle bar which, while having no greater overall dimensions nor greater cross-sectional area than a similarly shaped structural angle bar as now made, will at the same time resist greater stresses. This is accomplished by providing an angle bar whose center of gravity about an axis at right angles to one of its legs, the legs being at right angles to each other, is at a greater distance from the back of its other leg than in angle bars as now made."

With the angle iron having legs of unequal thickness, the inventor points out, there results an increase in the section modulus and, up to a certain point, an increase in the radius of gyration, giving a greater allowable stress per square inch of section.

Long Wheel Base Truck for Bulky Goods

A long-wheel-base (91 in.) electric storage battery truck has been added to the line of the Terminal Engineering Co., Inc., New York. The truck will carry 5,000 lb. and is intended for full-load capacity of bulkier goods than could be placed on the shorter-wheel-base model. This truck has a four-wheel electric motor drive, and steering is accomplished with all four wheels, making possible a short turning radius.

The truck is carried on four full leaf springs and wheels with solid rubber tires 20x5 in. Brakes of the internal

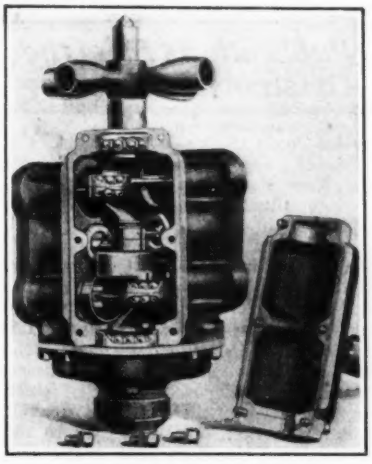


expanding type are ordinarily provided on two of the wheel units. Large wheels, individual drive and springs are intended to permit use of the truck without construction of special runways; it is able to traverse cinder fill, snow and ice and has a speed of 7 miles per hour loaded.

The truck is designed to use separable bodies, driving under them as they stand on legs and picking up by means of four screw jacks operated by a motor. The machine is furnished with a spring drawhead, so that it may be used as a tractor if occasion requires. The truck weighs 3,800 lb. without the battery; the battery weight is from 1,000 to 1,500 lb.

Ball Bearing Air Motor

With all moving parts mounted upon ball bearings the new air motor developed by the Cleveland Pneumatic Tool Co., Cleveland, Ohio, designed for reaming, tapping, drilling and counter sinking in connection with the erection of steel in bridges and buildings and for general railroad work, is claimed to have an unusually high drilling capacity. The machine is built in plain and compound geared types. The motor, operated by compressed air, is a four cylinder type with four single acting pistons connected to opposite wrists of a double throw crank, as shown in the illustration. The wrists of the crank are grooved, hardened and

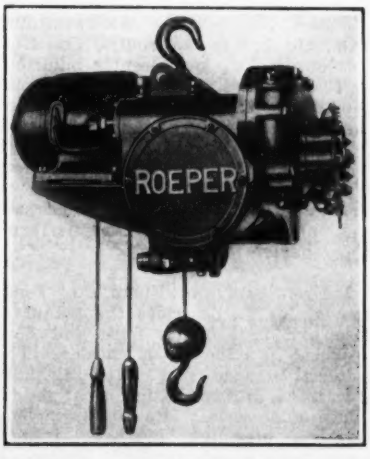


ground to act as an inner ball race and the connecting rods the outer ball race. The main valves are of the solid piston type and are operated from eccentrics on the crank shaft.

On account of the reduction in friction through the use of ball bearings and added power gained through quick delivery of air to the pistons, a high motor speed is obtained which is translated into power through different ratios of gearing direct to the spindle.

Small High-Speed Electric Hoist for Industrial Service

Designed in three sizes with lifting capacities of 500, 1,000 and 2,000 lb., for hook or I-beam trolley suspensions, a new small capacity high-speed electric hoist has been added to the line of equipment manufactured by the Roeper Crane & Hoist Works, Reading, Pa. The hoist is worm-geared, with the worm placed above the gear to reduce wear. The main frame is a one-piece casting containing all bearings so that



shafts and moving parts, once assembled, cannot get out of alignment.

Protection in extreme lifting and lowering is afforded by an automatic stop of the trip lever type, positive in action. The need of a load brake is removed by the worm drive. For operation the manufacturers provide either controllers of the single-speed drum type or a push button control.

Publications from the Construction Industry

Saw-Tooth Roofs — BALLINGER CO., architects and engineers, Philadelphia and New York, has just published a 16-page illustrated pamphlet on its patented super-span saw-tooth buildings, the feature of which is the adaptation of saw-tooth roof construction to structures 100 ft. wide without the use of the many columns formerly required with this general type of design. The feature of the design described is the use of light longitudinal trusses, directly in back of the glass, which are supported at their ends by heavier transverse trusses spanning up to 100 ft. The top chord of each transverse truss extends above the roof and ties together the peaks of the several saw-tooth skylights. Photographs and descriptions of a number of typical installations are given.

Pivot Valves — COFFIN VALVE CO., Neponset, Mass., and the S. MORGAN SMITH CO., York, Pa., have issued jointly a bulletin on the Dow disc-arm pivot valve. This form of valve, the manufacturers state, is the result of an attempt to combine the advantages of simplicity, economy, compactness and low head-loss characteristics of the ordinary type butterfly valve with a strength, reliability and tightness which the latter cannot claim. The desired ends are attained by the use of an arm of stream-line section cast integral with the disc, so located as to avoid reducing the section of waterway but permitting the application of force at the point where it is most effective in increasing tightness. Valves of this type up to 6 ft. in diameter are built by the Coffin company and above 6 ft. in diameter by the Smith company.

Steam Condensers — WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., has recently published a 44-p. booklet, known as Circular 1662, on steam condensers of the surface, low level jet, and barometric types, as well as auxiliary equipment, including air removal apparatus, pump drives, motors, and control equipment. The apparatus described is illustrated with photographic cuts and performance charts.

Fibre—SPAULDING FIBRE CO., Tonawanda, N. Y., describes the manufacture and uses of its fibre and fibre products in a new 48-p. catalog. The material is made from cotton rag pulp, vulcanized, in three basic forms; sheets, tubes and rods. Its uses include washers, bushings, journals, rollers, gears, truck wheels, conduits, insulators, and a great variety of other specialties. The material is manufactured in both hard and soft grades. The former can be machined, threaded or tapped. The sheets are made in six thicknesses from .005 to 3 in. and measure 48x72 in. Tubes are made up to diameters of 4 in. with wall thicknesses from $\frac{1}{32}$ to $\frac{3}{8}$ in. The rods range from $\frac{1}{16}$ to $2\frac{1}{2}$ in. in diameter and up to 6 ft. long.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Industrial Construction Heavier Than Year Ago In New England, South and West

A comparison of industrial construction awards for the first ten months of 1924 with those of the corresponding period last year, shows that for the entire country, in this line of work, the 1923 record remains unbroken.

New England, the South and the Far West are the only sections to exceed the 1923 totals of industrial awards. The first gained over last year by $108,000; the second, by $6,439,000; and the third by $3,860,000.

During the time under consideration, 1924 shows 1,089 awards with an average money value of $153,000, against 1,689 for 1923, with an average value of $140,000. While the 1924 awards are fewer, the money value per contract is greater.

The following table shows the situation in each section as to number of awards and total money value:

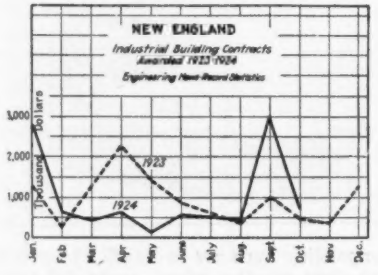
	1924		1923	
	No.	Value	No.	Value
North East...	148	$21,693,000	190	$21,585,000
Mid. Atlantic.	226	50,666,000	261	59,483,000
South.....	93	18,520,000	95	12,081,000
Mid. West.....	295	34,708,000	807	81,378,000
W. of Miss...	158	17,573,000	183	42,070,000
Far West.....	169	23,846,000	153	19,986,000
Total U. S.....	1,089	$167,006,000	1,689	$236,583,000
Canada.....	27	$6,358,000	52	$13,795,000

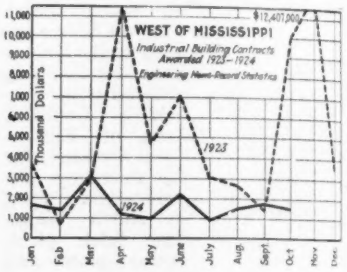
The accompanying charts depict the industrial building situation for the past two years. In New England the important rise is shown as occurring in September, with October higher than a year ago.

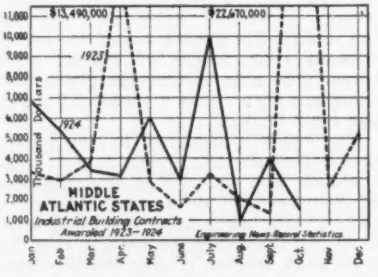
The summer months of 1924 are greater than those of a year ago for the Middle Atlantic states.

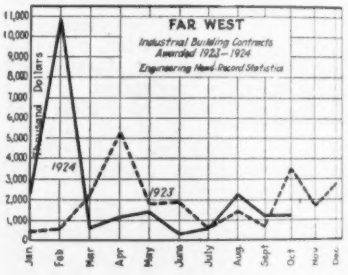
The South is below 1923 in May, June and October. The heavy awards during the first part of the year give it a lead over last year.

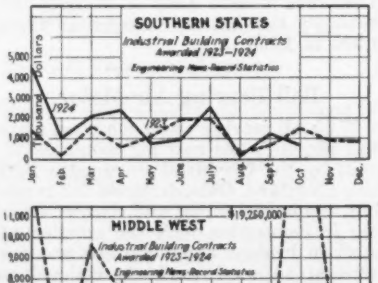
(*Continued on p. 893*)

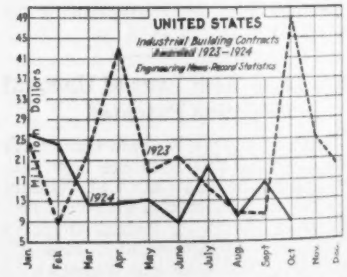


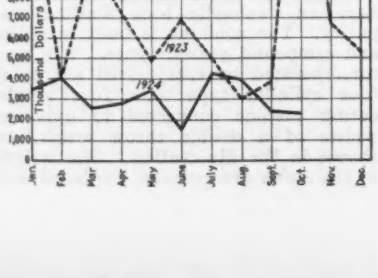


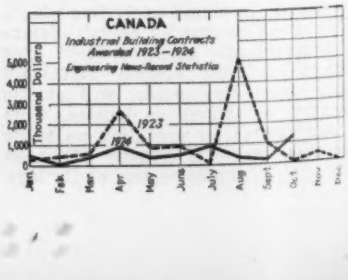












Danger of Materials Scarcity Apparent

Orders in Excess of Output In Most Cases—No Replenishment of Stocks—Rail Deliveries Prompt

Contracts awarded in the United States during the eight weeks ended Nov. 20, showed a gain of 20 per cent over the corresponding period last year.

Possibilities of a materials shortage arise with the prospect of a heavy winter construction program followed by a heavier spring demand.

From present indications activities will be greatest in water-works, excavations, sewers, commercial buildings and industrial construction with a continuation of the upward trend in residential work.

So far as availability of most of the basic materials is concerned the situation is about the same as a year ago.

Cement shipments are heavier than at this time last year, but production has also been increased to a corresponding degree.

Fewer burned brick are available this year than last, but orders have decreased in proportion.

The present steel output is below that of a year ago, but the total of unfilled orders is also smaller.

The present lumber situation threatens to start the movement in the direction of a materials shortage. Orders were over 21,000,000 ft. in excess of production for the week ended Nov. 8, 1924.

The accompanying tabulation shows the present situation, as to production and demand in four of the most important building materials, compared with a year ago.

PRODUCTION AND DEMAND—TOTALS FOR MILLS AND PLANTS OF ENTIRE COUNTRY

Steel	1924	1923
Ingot outfit, October, tons	—3,111,000	3,577,000
Unfilled orders on books, Oct. 31, tons	—3,525,000	4,672,000
Lumber (all grades)		
Production, week of Nov. 8, ft.	—213,669,000	248,556,000
Orders, week of Nov. 8, ft.	+224,152,000	203,118,000
Common brick		
Burned, available at yards, Oct. 1	—272,172,000	307,633,000
Orders, on books, Oct. 1.	—226,529,000	356,429,000
Portland Cement		
Production, October, bbl.	+14,820,000	13,350,000
Shipments, October, bbl.	+17,081,000	14,285,000

(+) Showing gain compared with year ago; (—) decrease.

In the case of hollow tile the same slowness of deliveries prevails in the Denver, Detroit and Philadelphia districts as existed last year at this time.

Lime supplies in Philadelphia are sufficient to meet current demands only; a year ago this material was plentiful throughout the entire country.

Sewer pipe was scarce last November in Denver, Chicago, New Orleans and New York. At the present time the slowness of mill deliveries is confined principally to the New York district.

Concreting materials and lumber, particularly the better grades of yellow pine flooring, are in good demand in New York City. A year ago lumber stocks were low in the Middle West.

Warehouse reserves of steel structurals are below normal in New York and mills supplying this district are not carrying heavy stocks.

Scarcity of asphalt in Detroit and of common brick in Philadelphia were reported during the week of Nov. 8, 1923. No shortages of these materials exist anywhere, to any appreciable degree, at the present time.

With the railroads of the country able to handle enormous quantities of freight without delay, any unusual demand incurred by active winter and spring building programs can be quickly met by increased production schedules at the mills.

Industrial Construction Heavier in N. E., South and West

(Concluded from p. 892)

The total of awards in the Middle West during August is the only lead for this section over last year.

The section immediately west of the Mississippi is very much under the 1923 curve.

Heavy February lettings prevent the Far West from dropping below 1923.

Declines thus far this year, in three of the sections of the United States, bring industrial contracts under the total for the corresponding period in 1923.

Bids Wanted on Big Jobs

Among the projects in Construction News, pp. 285 to 294 on which bids are either asked or will soon be called, are the following:

High School, Kansas City, Mo., by Board of Education, $1,500,000.

Pier, San Francisco, Calif., by State Harbor Comm., $1,000,000; also 2 story-ultimately 6 story, rein.-con. warehouse terminal, $500,000.

Fabricated Structural Steel Demand Slower

That bookings of fabricated steel structurals during October were slightly under those of the month preceding is shown in the report of the U. S. Department of Commerce dated Nov. 19, 1924.

The report is based on figures received from the principal fabricators of the country and the tonnage represents 66 per cent of the total plant capacity of 165 firms. Shipments were considerably heavier than orders.

BOOKINGS OF STEEL STRUCTURALS

	Actual Tonnage		Per Cent of Capacity	
	1924	1923	1924	1923
January	176,058	179,375	72	72
February	179,956	192,569	73	77
March	174,663	230,085	71	92
April	160,267	193,932	65	78
May	145,820	140,681	59	56
June	161,763	125,993	66	50
July	170,884	125,344	70	50
August	146,875	143,814	60	58
September	165,343	130,239	68	52
October	157,956	122,153	66	49

Since May of the current year, the demand for fabricated structurals has been greater than for the corresponding months in 1923. Last year there was a tapering off in demand at the beginning of the fourth quarter.

Business Briefs

Call money rated at 2½ per cent, Nov. 22.

Time loans; short periods, 2¾@3 per cent; longer terms, 3@3¼ per cent.

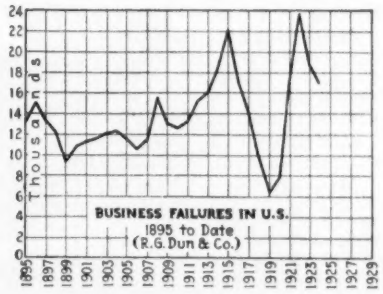
Commercial paper; best names, 3¼@3½ per cent; other names, 3½@3¾ per cent.

Foreign exchange (Demand):

	Normal	This Week	Last Week	Year Ago
Sterling	$4.8665	$4.63¾	$4.63¼	$4.64
Franc	0.193	0.0526½	0.0523¾	0.0685
Lira	0.193	0.0433¼	0.0433¼	0.0455

More Firms Failed During October Than At Any Time Since May

A larger number of commercial failures in the United States invariably occurs during the closing months of a year, and the October total reported to R. G. Dun & Co. exceeds that of any previous month since last May. Numbering 1,696, last month's defaults are compared with 1,306 in September, while the liabilities rose from $34,296,276 to $36,098,804. In point of number, the October failures increased about 30 per cent over those of September, which marked the low level this year, and the indebtedness was heavier by 5 per cent.



This is a better showing than was made in October of last year, when the 1,673 defaults were 36½ per cent above the number for September, and the liabilities of $79,301,741 were two and three-quarters times larger than the aggregate for that month. The failures during October of the current year, though slightly outnumbering those for the same period of last year, involved less than one-half the amount reported for the earlier period, this difference in the indebtedness being accounted for by a falling off in large defaults last month.

Thus, there were 48 failures for $100,000 or more in each case, involving $15,988,338, whereas in October of last year 81 such defaults occurred, with liabilities of $60,724,317. For ten months of 1924, all commercial failures, numbering 16,922 are compared with 15,173 for a similar period of last year; liabilities of $466,822,260 are contrasted with a total of $437,480,368 for ten months of 1923.

Large Contracts Let During Week

Apartment, Boston, Mass., 370 Commonwealth Ave., Inc. to Boyle-Robertson Construction Co., $1,000,000.

Mill, San Marcos, Tex., Planters and Manufacturers Co. to Lockwood, Greene & Co., $1,000,000.

Apartment, Montreal, Que., P. R. DuTremblay to A. Norcross, $3,500,000.

Freight Loadings Indicate Volume of Business

The seven new high records achieved by the railroads of the country in handling of enormous quantities of freight, are given as follows:

(From Report of the American Railway Assoc., Nov. 17, 1924)

(1) Greatest number of cars for any one week in history were loaded with revenue freight the week ended Oct. 25, when the total was 1,112,345 cars. This exceeded by 14,852 cars the record of 1923 which remained the peak until this year.

(2) The railroads for the week of Oct. 25 loaded 72,474 cars with grain and grain products, the greatest number for any one week on record.

(3) Loading of merchandise and less than carload lot freight totaled 259,617 cars the week of Oct. 11, the highest record for any one week ever reported.

(4) A new high record for any week in the loading of miscellaneous freight was made the week of Oct. 25 when the total was 422,890 cars.

(5) The railroads on Wednesday, Oct. 15, moved 1,030,211 freight cars, the greatest movement for any one day in history. This included both loaded and empty freight cars.

(6) High record in respect to number of surplus freight cars and serviceable locomotives in storage when loading of revenue freight was in excess of one million cars a week. At the same time there was no car shortage or congestion due to railroad disability.

(7) Over 31,700,000 cars loaded with all commodities excluding coal, coke, and ore, for the period from Jan. 1 this year to Oct. 25. This was the greatest movement of these commodities on record, exceeding by 363,182 cars or 1.1 per cent the previous high record for the corresponding period established in 1923. Loading of all commodities except coal, coke and ore represents about seventy-six per cent of the total traffic.

Merchandise and less-than-carload-lot freight consist of materials handled through local freight offices and not those loaded on sidings at manufacturing plants. This includes the output of smaller factories that are unable to afford private switching tracks.

Miscellaneous freight comprises carload lots of such materials as groceries, automobiles, dry goods, etc. Therefore, it may be contended that when these two classifications are being loaded in record breaking quantities, all business is moving at a fairly good pace.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 6, the next, on December 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	$3.50
Structural rivets, 100 lb.	3.75	4.35	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.45%	36%	44.7@55.5%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	55.60@56.60	56.00	—56.75	48.20@50.20	55.50	68.00	—55.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd.	2.00	1.90	2.38	2.75	1.65	1.90	2.61	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	55.00	34.00	57.20	55.00	38.75	36.75	29 00	—26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.50@3.00	1.45	1.85	1.50	1.35	2.70	1.60	2.80	10 50
Common brick, delivered, 1,000	18.00	10.50	12.10	12.00	+15.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	.085	.....	.11	12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	—1.11	+1.17	+1.22	1.05	1.17	1.29	1.16	1.12	1 13
Common Labor:									
Common labor, union, hour	.75	.30	.....	82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.40@ 75	.75	50@ 55	.35@.50	.50	.62½	25@ 30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.16¼. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Despite slight breaks in the building materials price line-up for the week, the general cost level (including labor) is about 0.6 per cent above that of the first week in November.

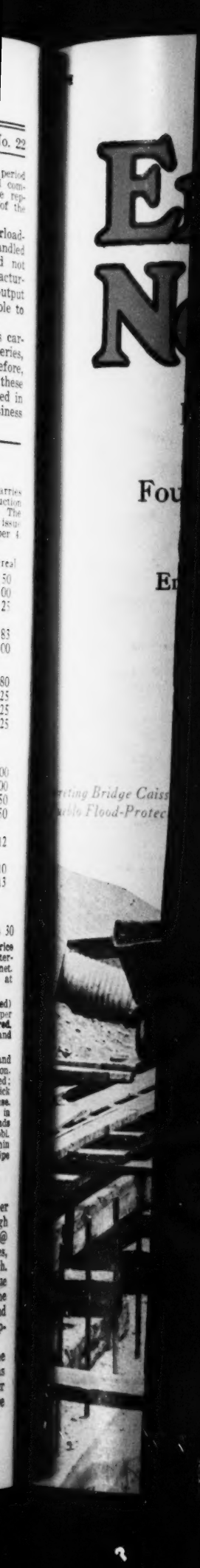
The steady downward trend in construction cost evident since May of this year, finally turned in an upward direction during the week ended Nov. 15.

The "slight breaks" referred to, occurred in linseed oil and Douglas fir timbers. The former dropped 3c. per gal. to $1.11 (5 bbl. lots) f.o.b., New York and the latter, $1 per M ft. b.m., to $26 delivered at site of job in Seattle.

Increasing price firmness is evidently due to the steady upward trend of construction since Nov. 1 and by prospects of active winter and spring demand for men and materials.

Iron and steel are at present exerting a strengthening influence upon the commodities' markets generally, and upon building materials, particularly.

Firmness continues in the pig-iron market, with No. 2 foundry, Southern, about 50c. per ton above a week ago. Nearly all items on the steel list have advanced during the week. Iron and steel scrap prices are also rising. The principal hot-rolled products are $2 per ton higher than last week at Pittsburgh mills. Reinforcing bars are now $2@$2.10; shapes, $1.80@$2, and plates, $1.75@$1.90 per 100 lb., Pittsburgh.

While building operations continue active in the United States with the consequent heavy demand for labor and materials, the Canadian situation appears to be quite the reverse.

Reports from Montreal state that the unemployment situation there has reached the acute stage and that over 10,000 unskilled common laborers are without work in that district.